

# GMD SYSTEMS

INSTRUCTION 2772-0803

## REMOTE INTELLIGENT SENSOR AREA MONITOR

Installation/Operation/Maintenance



Rev. 14 – February 2004 (CN #3252)

**SCOTT<sup>®</sup>**  
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## **Declaration of Conformity**

Manufacturer's Name: SCOTTINSTRUMENTS

Manufacturer's Address: 251 Welsh Pool Road  
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Product Name: Remote Intelligent Sensor

### **Conforms to the following product specifications**

EMC: European Directive 89/336/EEC  
EN 500081-1 (Emissions)  
EN 500082-1 (Immunity)

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**RIS TEST/FAULT PARAMETER LOG SHEET**

## FEATURES

- **TRUE CONTINUOUS MONITORING WITH RELIABLE PAPER TAPE DETECTION**  
Using GMD developed, optimized and proven tape technology.
- **MICROPROCESSOR CONTROLLED AND SOLID STATE LOGIC**  
For reliability, flexibility and calibration stability.
- **QUICK RESPONSE & AUTORANGING**  
Sophisticated, dynamic control of the sampling sequence provides a response time as low as 15 seconds, excellent resolution of short term peaks and economic use of tape.
- **LOCAL OR REMOTE WARNING**  
Highly visible display of measured concentration, system status, gas and system fault alarms. Remote warnings of gas and fault alarms via solid state relay interface. Optional audible and visual alarm module provides high impact additional warning.
- **CONTINUOUS DIAGNOSTICS & SYSTEM TEST MODE**  
Monitors the status of key parameters and enables the system to be kept in optimum condition.
- **BATTERY BACKUP**  
Integral backup battery automatically provides supply failure protection.
- **USER SELECTABLE ALARM SET POINTS**  
The default values assigned may be set at any value in the detection range through the system keyboard.
- **UP TO FOUR WEEK CASSETTE WITH INTEGRAL PURGE FILTER**  
One piece design eliminates tape handling and provides economy of use.
- **SYSTEM EXPANSION**  
Comprehensive area monitor schemes can be built one point at a time, each selected to measure the gas required.
- **OPTIONAL FEATURES**  
Printer option with storage of up to 7 days worth of data points.

## PRODUCT SPECIFICATION

### ACCURACY

ppb Ranges:  $\pm 15\%$  of reading  $\pm 1$  ppb.  
 ppm Ranges:  $\pm 15\%$  of reading  $\pm 0.01$  ppm.  
 2772-0020:  $\pm 20\%$  of reading  $\pm 0.01$  ppm.  
 2772-0035:  $\pm 20\%$  of reading  $\pm 0.02$  ppm.

### PHYSICAL

**Dimensions:** 7" Depth x 11.75" Width x 7.875" Height  
 (178mm D x 298mm W x 200mm H)  
**Weight:** 11.5 lbs. (5.2 Kg.).  
**Enclosure:** IP-55 with sealed glands (NEMA 4).  
**Cable Glands:** 3 x for input/output cables. Pre-wired connector for Optional Printer.

### POWER INPUT REQUIREMENTS

**External Power Supply:** 12VDC  
**Input Current:** Depends upon model and conditions.  
**Low Flow models:** (200cc/min or less) Cat.# 2772-0010/015/020/030/035/040/060/  
 090/095/100/110/150 etc.  
 Normal run current (charged battery) =150–200mA  
 Run current (discharged battery) =500–700mA  
**High Flow models:** (700cc/min or less) Cat.#272-0120/160/175 etc.  
 Normal run current, (charged battery) =250–300mA  
 Run current (discharged battery) =600–800mA

### OUTPUTS

**Solid State 'Relay' Output:**  
**Standard System:** 1 Combined Gas/ Fault Alarm.  
**Optionally:** 2 Gas Alarms plus 1 Fault Alarm, or  
 Devices rated @ 1A./60 V DC max.  
 Surge current (1 second) = 5A peak.  
 Turn on/off time = 50, ms.  
 On state voltage = 1.5V DC  
 Off state leakage at 60 V DC across the load = 200,  $\mu$ A  
**Logic:** Device normally 'closed', opens on alarm  
 (with standard system software).  
**Analog Output:**  
**Standard:** 4–20 mA is default on the instrument.  
 0–1 V DC can be hardware selected.  
 In both cases the minimum = zero concentration,  
 and the maximum value = system range maximum.  
 (Other configurations available. Contact Customer Service)



## PRODUCT SPECIFICATION (continued)

### DISPLAY

**Custom LCD Display:** Area measures 5.7" (145mm) x 3.2" (81 mm).  
**Displayed parameters include:** System Readiness status,  
Measured Concentration (3 decades of ppb or ppm),  
Tape Remaining, and Icons for Gas & Fault alarms.

**In the TEST Mode, display includes:** Alarm Set Point(s), System Current (mA),  
Alarm Type, Regulated Voltage (V), Active Gas Type,  
Track 1 & 2 Light Levels, and, Date & Time (with optional  
Serial Printer Interface PCB, Section 5).

**Alpha/Numeric characters:** 0.92" (23.4mm) high.

### KEYBOARD

**Membrane Switch Panel:** Four switches for the following functions:  
PRINT, 8 HR. TWA /DIGIT SET, 15 MIN TWA/DECADE,  
& HOLD/RELEASE.

### INTERNAL BACK-UP BATTERY

**Sealed Lead Acid Battery:** 6 v / 1.1 Ah Charge maintained with external power connected.  
(the internal power switch SW1 can be on or off).

### ENVIRONMENTAL

**Temperature Range:** -10 °C to +40 °C ( operating)  
(Instrument Only) Relative Humidity (System Hardware): 5-95% (non-condensing).

### SAMPLING INPUT

**FEP:** Teflon input tubes

### OPTIONS

**Printer option:** TTL serial interface and 7-Day memory.  
**Three (3) Relay option:** 2 x gas alarm outputs with adjustable set point and 1 x fault  
alarm output.

### CATALOG #, CASSETTE #, RANGES and MODEL

**DEPENDENT PARAMETERS:** See RIS Catalog Numbers and Data (Table #1).

**TABLE #1  
RIS CATALOG NUMBERS & DATA**

CATALOG NUMBER	GAS TYPE	GAS CODE	RANGE	UNITS	FLOW RATE	ALARM LEVEL 1	ALARM LEVEL 2	ANALOG OUTPUT
2772-0010	TDI	0	1000	ppb	200	5	10	100
2772-0015	TDI HIGH RANGE	5	2000	ppb	200	5	10	2000
2772-0020	HYDRAZINES	1	2.00	ppm	200	0.05	0.10	2.00
2772-0030	PHOSGENE (A)	3	5.00	ppm	100	0.05	0.10	0.30
2772-0035	VELCORIN®	35	2.00	ppm	200	0.05	0.10	2.00
2772-0040	CHLORINE	7	2.00	ppm	170	0.05	0.10	2.00
2772-0060	ARSINE	8	1000	ppb	200	25	50	100
2772-0090	ACID GASES	9	2.00	ppm	150	0.05	0.10	2.00
2772-0095	HCl HIGH RESOLUTION	10	100	ppb	250	5	10	100
2772-0100	HDI	2	500	ppb	200	5	10	500
2772-0110	PHOSGENE (B)	4	5.00	ppm	100	0.05	0.10	5.00
2772-0120*	MDI	6	200	ppb	700	5	10	200
2772-0150	IPDI	12	1000	ppb	200	5	10	100
2772-0160*	MDI, TDI, IPDI	97	200 MDI 100 TDI 200 IPDI	ppb	700	5	10	200
2772-0175*	TDI HIGH FLOW*	14	100	ppb	700	5	10	100

\* High Flow, all others are Low Flow

# 1 INTRODUCTION

## 1.1 SYSTEM DESCRIPTION

A range of Remote Intelligent Sensors (RIS) are available. Each is designed to measure low concentrations of a specific gas. Multiple RIS systems can be connected into a control network to provide an area monitoring capability with central supervision.

The RIS is a single point, microprocessor controlled, instrument for use in a fixed location. Two RIS versions were produced (see Supplement A for units built before April '92).

The RIS is housed in an environmentally sealed enclosure and is line-powered, via a DC power supply, for continuous monitoring. An internal backup battery is provided as protection against power interruptions.

The standard system provides clear visual indication of status, concentration level, 4-20 ma analog output, gas, and fault alarm conditions. TWA's, 15 minute and 8 hour, are displayed at the touch of a keyboard button.

Reliable and effective operation is assured by on-line self-diagnostic routines. An easy-to-use TEST Mode allows key parameters to be checked and adjusted.

Optional features provide storage, and printout, of up to one week's data points, two independently selectable (via keypad) alarm relays with a separate fault indication relay and a hardware selectable 0-1 VDC analog output (Sections 2.4.5 & 2.7).

## 1.2 BASIC PRINCIPLES

A measured sample volume is drawn into the RIS and passed through a chemically impregnated paper tape. The tape reacts to the presence of a specific gas by developing a stain whose intensity is proportional to the sample concentration.

A beam of light is bounced off the tape and the reflected light is measured. The difference in reflected light values, developed before and after the stain, is used to calculate stain intensity, enabling the sampled gas concentration to be determined.

The measurement of low gas concentration levels takes place during a fixed four minute sample period. If the sample concentration rises above a predetermined value, the operating mode changes and the system measures the time taken for a given stain value to develop.

This technique provides a wide dynamic range, good resolution and a rapid response to rising gas levels. In addition, the tape never becomes saturated which ensures accurate measurement, and toxic gases are prevented from breaking through the tape into the system. A double track, tape management system gives maximum tape economy.

This combination of operating features gives long tape cassette life at low sampling levels, and a rapid response with excellent tracking of short term peaks as levels rise.

The detection of a gas concentration that is higher than the user-adjustable alarm set point, results in a highly visible warning on the RIS's large custom display. In addition, local and remote external warning devices or systems can be activated via interface signals.

## 1.3 GENERAL DESCRIPTION

**1.3.1 ENCLOSURE.** The instrument is contained within a tough, IP-55 rated, enclosure that is suitable for installation inside and out. A large liquid crystal display (LCD) is mounted in the front face of the door next to a membrane keyboard that is used for programming certain functions.

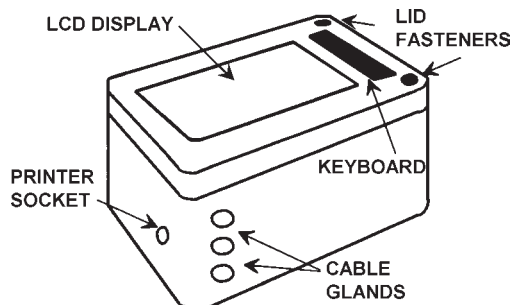


Figure 1-1. Enclosure

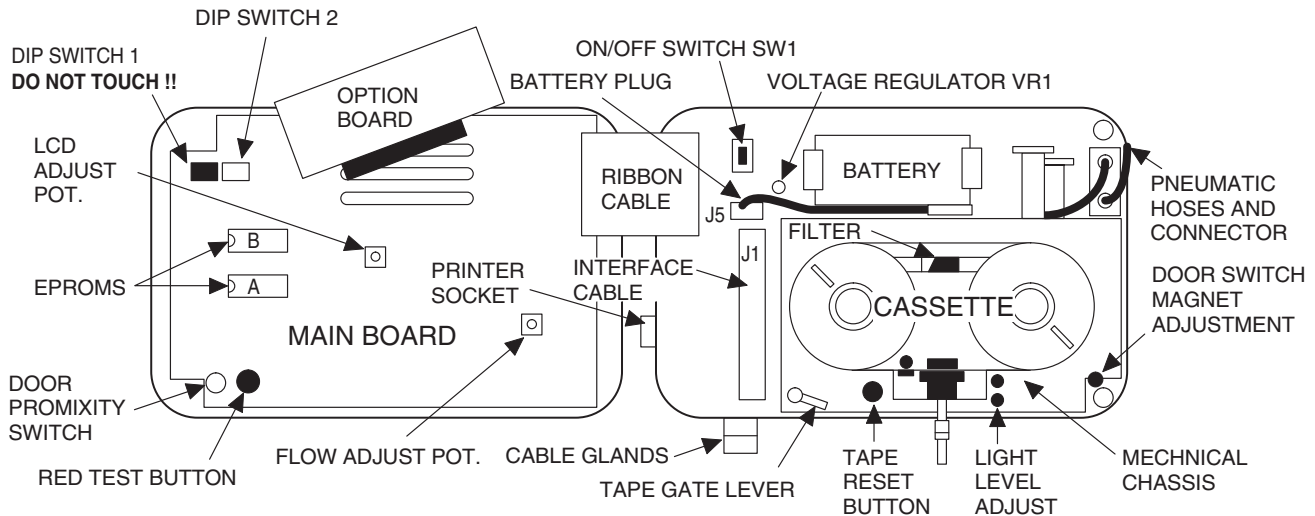
The door is hinged on one side and secured shut by two screw fasteners, which are opened with a special key to discourage unauthorized tampering. The door hinges are easily disengaged and removal of the door from the base is quick and simple, should this ever be required.

A door-open fault display icon, and relay output provide warnings and help ensure that RIS is only operated when the enclosure is secured shut.

There are threaded mounting holes in the base of the enclosure. The mounting brackets are supplied with the system.

**1.3.2 CABLE GLANDS.** Three sealed glands are provided for cable entry and exit. A socket is provided at one end to allow the connection of an optional printer.

**1.3.3 MAIN SYSTEM BOARD.** The board is mounted on the rear face of the door and is accessible when the door is open. The red push-button TEST Mode switch is in the bottom left-hand corner, as viewed with the door open.



**Figure 1-2. Door Open and Cover Removed from Back of Door**

On the main board are mounted several potentiometers and 'dip' switches. These should not normally be touched, **particularly dip switch 1**. However, a potentiometer (POT) is provided for user adjustment of the pump flow rate. The location of the POT is shown in Figure 1-2 and an explanation of how the flow rate is adjusted is provided in Section 4.5.

System operating software is stored in two EPROM's that are fitted on the board and marked with the version number. These devices should not be normally touched or removed except if a factory upgrade is received.

The main board is protected by a black molded cover held on by two screws and two pegs.

**1.3.4 SYSTEM POWER SWITCH SW1.** RIS operation is controlled by a switch mounted on the base board. SW1 is located at the top left of the right hand unit, see Figure 1-2.

When SW1 is 'OFF', the system is **off**. With the switch 'ON', the system will operate from the external 12 volts input, or the systems back-up battery if the external power is disconnected, or fails.

**1.3.5 MECHANICAL CHASSIS.** This subassembly carries the optic block and its associated PCB, the tape drive mechanism and take-up drive clutch.

Also mounted on the chassis is the pump, with the pneumatic elements and plumbing necessary for the track switching and purge functions. The tape cassette is mounted directly on the front face of the chassis.

**1.3.6 BACK-UP BATTERY.** The lead acid battery is located immediately above the mechanical chassis and is secured to the system base board with metal clips. It is connected to the system via a short cable plug and socket (J5).

The battery is automatically 'float charged' whenever the RIS is connected to a 12 VDC supply. **The battery is charged with SW1 off or on.** If the RIS supply fails, the back-up battery will keep the system running for 2-3 hours. The support time depends upon the system type, specification, and the battery condition.

If the RIS is being shipped, or will remain unused and disconnected from the input supply for more than a few days, it is good practice to disconnect the battery, at the plug and socket.

**NOTE:** *If the internal system switch, SW1, is left on and the RIS input supply is disconnected, the battery will discharge. If the RIS input supply is disconnected, the battery will discharge, irregardless of SW1 being on or off.*

**1.3.7 BASE BOARD.** This is a printed circuit board fixed to the base of the enclosure. It provides the interconnection between the subassemblies mounted on it and the main circuit board on the door.

Other circuit elements located on this board include; the analog output, solid state output 'relays', interface terminal strip J1, voltage regulator potentiometer VR1 and system switch SW1.

The current Phase 2 boards have 3 solid state 'relay' devices. Terminal identification and numbering have varied and the appropriate interface diagram should be used. Both versions are shown in Figure 2-3.

**NOTE:** *The earlier (Phase 1) versions (Produced before April '92) are described in Supplement A, in the rear of this manual.*

The 3 'relay' devices are standard, but only one 'relay' output is active and available unless the optional Alarm Relay PCB (Section 5.5) is installed.

**1.3.8 SAMPLE INLET.** The sample is brought into the RIS through the short length of black FEP tube and into the optic block. There are two types of input tube; one has a single 0.25 inch (6 mm) diameter tube, the other is a double tube arrangement used for systems that monitor aerosols.

**NOTE:** *It is essential that the input tube is correctly fitted, if incorrectly fitted, the measurement will be inaccurate (Figures 2-4 & 2-5).*

## NOTES

## 2 INSTALLATION AND SYSTEM CHECK

The RIS may be installed inside or out. It should be mounted and connected according to the instructions provided below, and in an environment that is within the specified limits detailed in the Product Specification.

### WARNING

*Failure to comply with these recommendations may void the warranty.*

### 2.1 UNPACKING

Carefully check for shipping damage by examination inside and out. In case of damage, retain packing and make an appropriate claim against the carrier.

### 2.2 BATTERY CONNECTION

Open the RIS door with the key provided and reconnect the battery lead at J5 (see Figure 1-2).

**NOTE:** *Do not turn the main system switch, SW1, on at this stage.*

### 2.3 MECHANICAL INSTALLATION

See Figure 2-6 for enclosure dimensions and mounting points. When deciding mounting arrangements and position, consider the following requirements:

**It should be possible** to fully open door for cassette replacement, service and maintenance.

**Adequate clearance** is required for connection of external wires and pipes through the glands provided.

**RIS must be located** so that the sampling input tube(s) does not require extending (Section 2.6).

**The mounting position** should be such that the installation of other equipment will not subsequently interfere with enclosure access.

**It should not be possible** for strong light, natural or artificial, to shine directly up the input tube(s). Servicing will be aided if suitable lighting is provided.

**NOTE:** *Ensure the sample inlet tube(s) are correctly inserted in the optics block (see Figures 2-4 & 2-5).*

### 2.4 ELECTRICAL INSTALLATION

**2.4.1 CABLE RECOMMENDATION.** When deciding cable size and length, the following criteria should be used.

The maximum permissible volt drop across supply cables and termination at an assumed 500 mA = 1 volt. Therefore cable length and size should be selected so that the maximum resistance of cable and termination is 2 Ohms.

This requirement is achieved by the cable recommendations given below. The voltage measured at J1 terminals 1 and 2 with a system taking a 'normal' current of 150-250 mA should be not less than 11.5 volts.

The following guidance on cable size and maximum length should be observed:

**2.4.1.1 PSU to RIS Input.** 18 AWG stranded, screened, copper wire x 300 ft. maximum, or 16 AWG stranded screened copper wire x 450 ft. maximum.

**2.4.1.2 PSU to Alarm Module.** 18 AWG stranded, screened, copper wire x 600 ft. maximum, or 16 AWG stranded screened copper wire x 900 ft. maximum.

**2.4.1.3 RIS Relay Output to Alarm Module.** Approximately 5,000 ft. maximum of 18 AWG stranded, screened, copper wire.

**2.4.1.4 0 - 1V Analog Output.** Dependent upon the input impedance of the device being driven. Check with manufacturer. As guidance, with a device having an input impedance of 10 megohm, a run of up to 1,000 ft. of 18 AWG stranded, screened, copper wire should be satisfactory.

**2.4.1.5 4 - 20 mA Analog Output.** 18 AWG stranded, screened, copper wire x 500 ft. maximum.

**2.4.2 POWER SUPPLY AND INPUT CONNECTIONS.** The power supply enclosure can be mounted adjacent to the RIS, or in some other convenient location. Advice on power supply selection is provided in Section 2.5.

Connect the 12 volt DC input from the external power supply to the J1 interface terminals #1 (0V) and #2 (+12V). Connect external devices/alarms as required.

When input connections have been made, and 12 volts DC is available at J1 terminals #1 & 2, leave the system connected overnight with **system switch, SW1, off during the recharge.**

**WARNING**

*Each RIS power supply must be connected to line voltage by a separate circuit back to a main distribution point. The connection should not be to a circuit that is liable to be switched off at, say, the end of a shift. Failure to observe this advice can result in a deeply discharged battery, interrupted RIS operation, and premature battery failure. This is because an external interruption of power will result in RIS running on internal battery until it is discharged, unless power is restored before total discharge.*

The circuit should be fused according to normal practice and provided with a switch for use during maintenance.

**2.4.3 OUTPUT CONNECTIONS.** Connect external wiring to standard and optional features as required and according to the interface Figures 2-2 and 2-3. Observe the general guidance below.

**2.4.4 RELAY OUTPUTS.** The alarm and fault relays, combined into a single output in a basic RIS, are solid state semiconductor devices. The outputs normally present the equivalent of a closed contact to the external circuit and open on alarm or fault. The output terminals at J1 terminal strip are polarized and care is required when making connection to the external circuit.

The semiconductor device specification is included in the Product Specifications and ratings should be observed.

It is recommended that external relay coils, or other devices, controlled by the RIS interface are not energized from the 12 VDC input supply to the RIS. This will avoid a possibility of overloading the power supply.

**2.4.5 ANALOG OUTPUTS.** A 4 - 20 mA analog output is available (as default) at the interface terminal strip J1. An external analog instrument may be connected to provide remote indication of the measured concentration.

An optional 0 - 1 Volt analog output is available. To set the 0 - 1 Volt output, follow the procedure in Section 2.7. The 20 mA, (or 1 Volt if appropriate), represents the maximum concentration value for the particular RIS monitor.

**2.5 SYSTEM POWER SUPPLY CONSIDERATION & SELECTION**

**2.5.1 RIS POWER SUPPLIES.** The following standard power supplies are available, higher output alternatives can be offered where necessary. See Chapter 5 for proper Power Supplies and Part Numbers.

**2.5.1.1 'Single Point'.** This power supply is suitable for permanent installation to supply **one** RIS plus **one** GMD Alarm Module.

**Specification:**

AC Input: 100/120/220 VAC + 10% - 13%  
230-240 VAC (47-63HZ) + 15% - 10%

Regulation:

Line: ± .05% for a 10% I/P change  
Load: ± .05% for a 50% load change

Output Ripple: 5 mV peak to peak

Short Circuit and Overload Protection:  
Auto current limit fold back

Temperature Rating: 0 to 50 °C full rated,  
de-rate linearly to 40% at 70 °C

Enclosure:

NEMA 3R rain tight  
Meets US 50 type 3R LEC 529.IP32  
Size 6.75" H x 4.375" W x 4.375" D  
(172mm x 111mm x 111mm).

**2.5.1.2 'Multi Point'.** This power supply is suitable for permanent installation to supply multiple RIS/ Alarm combinations.

**Specification:**

AC Input: 104-127 VAC, 208-254 VAC,  
both 50-60 Hz.

Regulation: Combined Line & Load = ± 0.1%

Output Ripple: 10mV RMS

Short Circuit and Overload Protection: Auto  
current limit fold back

Temperature Rating: 0 to 55 °C ambient

Temperature Coefficient: 0.03%/°C

Max. Output Current: 120% rated current  
= 1.8x 120%=2.16A

Enclosure: NEMA 4X

Size\* 10"H x7"Wx6.25"D  
(254mm x 178mm x 159mm)

\*including flanges and connectors.

The following table shows the combination of RIS's and Alarms that may be connected to one 'Multi Point' supply. Practical worst case conditions are assumed to apply. See Table #1 for the High Flow models.



RIS TYPE	Acceptable Combinations			
Standard and Alarm Module	4 +	3 or +	2 or +	1 or +
	0	2	4	8
High Flow and Alarm Module		3 +	2 or +	1 or +
		0	4	7
Alarm Module	10			

**NOTE:** In large applications physical layout and distance between RIS's and Alarms may make it more convenient to use some small local power supplies.

**2.5.2 POWER REQUIREMENTS, RIS & ALARM MODULE.** Typical current consumption under a range of operating conditions are:

**2.5.2.1 Standard RIS Models.** All Standard systems (See Table #1) have Flow Rates of 200 cc/ min. or less. This list may be incomplete because of new models introduced after publication.

The input current taken by an RIS depends upon the following factors. The battery charge state, its condition and age, the operating point in the cycle, pump current and the options fitted.

Typical input current, under several conditions:

**Normal conditions, well charged battery.**

Conditions and Comment	mA
System running, no pump (as measured in the TEST Mode, mA test)	60-90
System running, pump on (measure at J1 terminal #2, or as shown on print header)	150-200

**Battery discharged, power just restored.**

Conditions and Comment	mA
System running, pump on. (Current shown is short term peak and would only occur after a prolonged power disruption. An old battery tends to take a lower charging current)	500-700

**2.5.2.2 High Flow RIS Models.** All of these systems (Table #1) have a the larger pump taking an additional current of, typically, 100 mA. All other factors are as detailed under Section 2.5.2.1.

**2.5.2.3 'Worst Case' Current.**

**Low Flow RIS.** A practical 'worst case' current of 500 mA may be considered reasonable under most situations. Where long-term power disruptions (more than 2 hours) are likely, it may be prudent to assume 550 - 700 mA 'worst case'.

**High Flow RIS.** A practical 'worst case' current of 600 mA is reasonable in most circumstances; in severe conditions 650 - 800 mA may be prudent.

**2.5.2.4 Alarm Module.** With both horn and flasher alarms operating and a well charged battery, the input current is typically 100 mA.

After a power interruption, with the battery discharged, and the alarm in the 'standby' state (both horn and flasher off), a practical 'worst case' current of 200 mA is considered reasonable.

**2.5.2.5 Summary: 'Worst Case' Input Currents.**

Model	'Practical' Worst Case	'Extreme' Worst Case
Low Flow	500 mA	700 mA
High Flow	600 mA	800 mA
Alarm Module	200 mA	250 mA

**2.6. SAMPLE LINES**

**2.6.1 GENERAL.** The RIS is designed, tested and calibrated to give accurate measurement of the target gas when used **as supplied** and as directed in this manual. This particularly includes using the short input tube fitted to the RIS. The input tube, material, diameter and length have been carefully selected so that no attenuation of the sample occurs as it is drawn into the monitor for measurement.

**NOTE: GMD Strongly Recommends** only the original input tube be used. Refer to Section 5.3 (Recommended Spares).

**2.6.2 LESS REACTIVE GASES.** They are less liable to be 'lost' in sample lines but many factors are involved. These include temperature, humidity, and sample velocity.

It **may** be possible with some of these gases, and under specific circumstances, to use somewhat extended sample lines. It is not possible to give more specific guidance on this subject than the following comments:

The less reactive gases referred to above include, **PHOSGENE, HYDRIDES and CHLORINE.** In some circumstances, it may be possible to use an input tube of **up to a maximum** of about 36 inches (0.91 meters) in length. The material **MUST** be black FEP Teflon fitted to the RIS as supplied.

**2.6.3 REACTIVE GASES.** Many gases are extremely liable to attenuation and **no extension of input tube should be attempted.** These gases include **ISOCYANATES, HYDRAZINES and ACID GASES** such as **HF and HCl.**

**2.6.4 SYSTEM PERFORMANCE WITH EXTENDED SAMPLE LINES.** Bacharach will not guarantee system performance and accuracy if extended sample lines are fitted, except where the company has expressly given written approval.

*NOTE: Without such specific approval, the user must determine that performance is not adversely affected under the particular application conditions.*

**WARNING**

**Extended input lines should never be used when sampling low vapor pressure compounds such as MDI. These compounds are present in aerosol form, and sampling efficiency will be drastically reduced if the sample line is extended. Instruments intended for aerosol sampling have a dual input tube approximately 1" (25 mm) long protruding from the bottom of the instrument.**

**2.7. 0 - 1 VOLT CONVERSION**

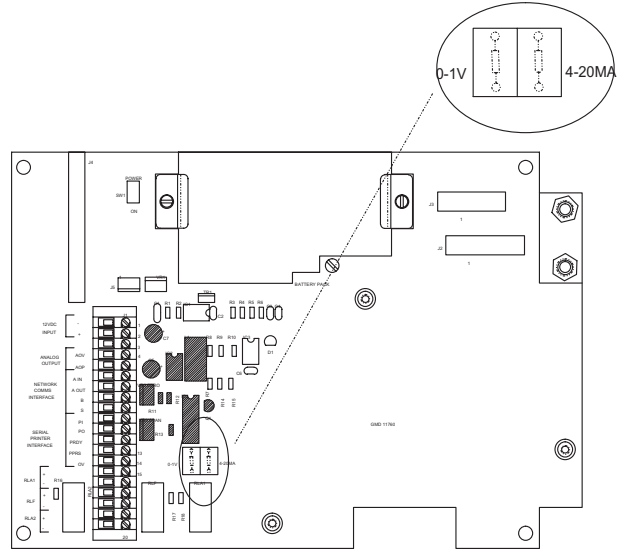
**2.7.1 TOOLS & MATERIALS REQUIRED**

- 2.5 mm Hex Key
- Soldering Iron
- Solder
- Wire Cutter (Small)
- Buss Wire (#22 AWG, 1/2" Long)

**2.7.2 PROCEDURE.** Remove main power from RIS System: then set ON/OFF switch SW1 to OFF. Follow the removal of the mechanical chassis from Section 4.11.2.

Remove link (0 Ohm resistor) from the 4 - 20 OUTPUT position using wire cutters to cut both ends of the link. Solder buss wire link into the 0-1 Volt position per Figure 2-1.

Reinstall the mechanical chassis, cables, and hoses using the first two paragraphs of Section 4.11.5.



**Figure 2-1. 0 - 1 Volt Conversion**

**2.8 SYSTEM CHECK**

*NOTE: This procedure should be followed every time a new cassette is installed, to insure the system is operating correctly. During the initial system check of this unit, and at least on a yearly basis there after, the sample inlet tube should be checked for proper installation.*

**2.8.1 TAPE CASSETTE LOADING**

**WARNING**

*This involves opening the RIS door, which automatically initiates the door-open alarm. Before opening the door to load or change a cassette, ensure that any external warning system is disabled or that those involved are aware of your intended actions.*

Open the door with the key provided. Leave the system switch **on**. Press the TEST Mode switch on the bottom left inside corner of the door. Open the tape gate with the lever and remove the old cassette, if installed. The cassette and its mounting spigots are designed to fit tightly; use a firm and direct pull to disengage the cassette. See Figure 1-2 for the location of the items referred to.

*NOTE: Make sure that the 'O' ring installed in the cassette molding, (and which seals purge connections), is not left behind when the cassette is removed.*

If the 'O' ring is left on the purge spigot the new cassette will not seat fully and faulty tape handling will occur.

Push the new cassette firmly into position. When doing so make sure that the tape enters the open gate and does not catch on the side and break.

If the tape is not tight and in the correct position to enter the gate, carefully tighten it by turning the take up spool.

It is **not necessary** to touch the tape directly. Touching the tape with bare fingers is undesirable because of chemicals used to impregnate the tape.

When the cassette is in position, close the tape gate and press the tape reset button to reset the tape counter (to 99%) and initiate a new cycle.

**NOTE:** *It is recommended that before exiting TEST Mode, the System Parameters are checked as described in Section 2.8.2. The check takes a few minutes and ensures that the system is in optimum adjustment.*

Exit the TEST Mode by pressing the red button inside (on the door) again and close the door. Tighten the door screws and take care not to over tighten them. The above procedure is summarized in the following:

- Disable** external alarms & warn staff.
- Open** door and enter TEST Mode.
- Remove** old cassette, check for retained 'O' ring.
- Fit** new cassette and close gate.
- Press** tape reset button & observe tape step.
- Check** system parameters.
- Exit** TEST Mode and close the door.

## 2.8.2 CHECK AND ADJUST SYSTEM

**PARAMETERS.** This procedure can be carried out if a system fault is reported, as a routine check after cassette replacement, or at any other time it is necessary. The full sequence of data displayed in the TEST Mode depends upon the options fitted to the particular system. All tests are given below for completeness.

The parameters that are normally checked at cassette change are: **V** system voltage, **mA** the current, **Light Levels** track 1 & 2, and **Flow Rate**. The others are set values that do not change unless the system is switched off.

**Entering the TEST Mode.** Open the RIS door, having taken precautions against causing unnecessary alarms, and enter the TEST Mode by pressing the red button on the rear of the door. Each of the TEST Mode displays remains for 3 seconds before stepping to the next parameter.

This cycling of data repeats continuously until the HOLD/RELEASE key is pressed to hold a displayed parameter; or the TEST Mode button is again pressed to exit the mode; or five minutes passes. After five minutes an automatic return to the NORMAL mode occurs.

**2.8.2.1 V, System Voltage.** The first displayed data is system voltage. This is the regulated voltage derived from the nominal 12 VDC external supply at the system interface. The displayed value should be **6.9 ± 0.1V**.

If adjustment is required, first press the HOLD/RELEASE key to hold the display. Adjust by turning potentiometer VR1 located on the base board near the system switch SW1 (**NOTE: See Supplement A for older version PCB's**). When adjusting, do so cautiously and allow time for the battery voltage to settle to the new value. Recheck the voltage 10 minutes after adjustment.

**2.8.2.2 mA, 'Charger Current'.** This display shows the system current taken under the test conditions. Pump current is not included because the pump is not running during this part of the test cycle.

The displayed current, in mA, is the total of that taken by the system, (excluding pump), and the battery charging current. A 'normal' reading is about 60-90 mA. This assumes a well charged battery and an average specification system.

Note that if the system voltage is lower than 6.9 V, the charge current will be proportionately higher. A mA reading that is much higher than the range shown above suggests a discharged or faulty battery if the system volts are correct.

**2.8.2.3 Alarm Set Point.** The numerical value in ppb, or ppm, (system dependent) is shown with the 'flashing bells' icon. If the set point has not been changed, the default value will be active. Default values are shown in Table #1.

To change the set point value, 'hold' display with the HOLD/RELEASE key. At this point the least significant digit will flash and it can be changed as required by pressing the DIGIT key. Each press steps one digit more. Press firmly.

When the first digit is selected, step to the next higher decade by pressing the DECADE key. Again use the DIGIT key to select the required number, and so on. On completion, press the HOLD/RELEASE key to allow the sequence of test data to continue.

**2.8.2.4 Alarm Level 1 and 2.** When the Relay alarm option is fitted, there are two Alarm Levels and each may be user adjusted. Both Alarm Level set points are displayed in sequence when the option is fitted.

Alarm Level 1 is displayed first and is identified by the number 1 which is shown in addition to the numerical set point value. Similarly, the Alarm level 2 set point which follows, is identified by a 2.

**IMPORTANT:** *Be aware that if the RIS is switched off at SW1, the alarm set point(s) will be return to their default at system switch on. It will therefore be necessary to reestablish set points if they differ from the default values.*

**2.8.2.5 Gas Curve.** The gas curve for the system is displayed as a number. Systems are fitted with an alpha numeric display and the active gas curve shown directly (e.g., MDI or TDI etc.). Most systems have only one gas curve programmed in the software and that curve is permanently active.

**2.8.2.6 Multi Gas Curve Systems.** In special 'multicurve' systems, a curve can be selected by:

1. Pressing TEST switch to enter the TEST Mode.
2. Wait until the display scrolls to the gas curve.
3. Press HOLD key to freeze the display.
4. Press DIGIT key to select the required curve.
5. Exit the test mode.

**NOTE:** *The 'default' curve is MDI and is automatically selected at system power up.*

**2.8.2.7 Light Levels Track 1 & 2.** The next display in sequence, is track 1 light level value. This is a numerical value between, approximately, 200 and 254. Also displayed is a separate 1 (for track one). This is followed by the next display with a similar reading and a 2 (for track two).

The '**correct**' value for both light levels is 220. However, variations occur normally because of small changes in the reflective property of the tape along its length. These variations do not normally exceed  $\pm 2$  or 3. If the light level reading is  $220 \pm 2$  or 3, do not adjust. If it is approaching 200, or more than 235 it should it be reset to 220.

**NOTE:** *The light level may vary slightly tape to tape. It is essential that checking and adjustment is only made with a tape in the gate and the gate closed. See Section 4.4 for detailed instructions on adjustment.*

**2.8.2.8 Flow Rate.** While the light level test cycles are active, the pump is running and 'sample Flow Rate' can be checked. This is done by HOLD-ing the display at 1. (and afterwards at 2.), and measuring Flow Rate with a suitable flow meter connected in series with the sample inlet tube.

Be aware that each system has its particular Flow Rate as shown in Table #1. After track 1 flow has been read, press the HOLD/RELEASE key to 'release' the display. Allow it to step to track 2 and press the key again to 'hold' that reading.

Flow to both tracks is supplied by one pump and switched to the active channel by solenoid valves. The flow measured at each track should therefore be similar. Adjustment to the pump flow is made with the potentiometer located on the main board as shown in Figure 1-2 and is described in Section 4.5.

**2.8.2.9 Date & Time.** If the Optional Printer card is installed, the data displayed in the Test sequence automatically includes the date and time. The date and time are reset to zero, with any stored data point information, when the system is switched off at SW1. It is necessary to set the date & time when the system is installed, and if it is switched off subsequently.

**'HOLD' Setting Date & Time.** To set the date and time, 'hold' the display and use the digit and decade keys to select the required values. The decade that flashes after the display is 'held' is adjusted first in each case.

If the number required is stepped past, keep going until the desired number comes round again. Note that the date & time is not lost if the input supply fails, providing the back-up battery is not discharged and SW1 remains on.

**2.8.2.10 Interruption of TEST Mode Cycle.** If 5 minutes have elapsed since entering the Test Mode, the display will revert to "normal". To complete the adjustments, press TEST Mode switch again to reenter the mode and carry on.

**2.8.2.11 Completion of Checks.** Exit the TEST MODE by pressing the red TEST BUTTON again on the rear of the door.

**NOTE:** *It is occasionally possible to initiate a display that contains both 'normal' and 'test' data simultaneously. If this occurs when exiting the TEST Mode, press red TEST MODE button to reenter the mode and then again to exit it cleanly.*

When installing a new tape, press the red TAPE RESET button on the left of the tape gate to reset the system and the tape counter.

Close the door and tighten the securing screw fasteners. The display should now show: **SYSTEM OK** and a zero **NUMERICAL ppm/ppb** value (assuming monitored atmosphere is zero) alternating with **99%** which indicates the cassette life available. There should be no fault icons shown.

## 2.9 OPTION PCB INSTALLATION

Under the cover on the main board are three slots for mounting option boards. An option board can be inserted in any available slot. The two option cards available are the Serial Printer Interface PCB, and the Alarm Relay PCB (See Section 5.5 for order numbers).

### 2.9.1 PRINTER (OPTION) INTERFACE

**INSTALLATION.** A suitable external printer can be connected when the printer option is fitted. This is a 'plugable' option and may be added any time. Section 3.14 explains the user selectable aspects.

The Printer option is a user installed feature for which the external printer socket is pre-wired. To install, proceed as follows:

The following parts are required: Printer PCB, Portable Printer (See Chapter 5 for part numbers) complete with charger and lead.

**Refer** to Sections 3.14.3 and 3.14.4 and set the switches on the Printer board to select the desired date format, printer interval and the baud rate. When handling the option board wear a wrist strap with the clip grounded at RIS common.

**Disable** external warning systems controlled by the RIS to avoid unnecessary alarms.

Open the RIS door and switch off the system at SW1. Before fitting the option board, wear a wrist strap with the clip grounded at RIS common. Terminal # 1 on J1 can be used.

If a wrist strap is not available, avoid touching components on the option board and the main board.

Slide the Printer option board into a slot and engage the connectors. If the board is not put in correctly, the connectors will not mate.

Set the date and time using the procedure in Section 2.8.2.9.

Replace the cover on the main board, plug printer into external socket provided, turn on the printer, wait for the printer to print "Ready", and check printer operation by pressing the PRINT key.

**2.9.2 PORTABLE PRINTER.** This printer is supplied complete with internal battery, charger and interconnecting cable. A fully charged printer battery allows for printing a complete 7 days worth of data. The printer can also be used 'on line' via the supplied charger. See Section 3.14 for printer operation.

**2.9.3 ALARM MODULE CONNECTION.** The GMD Alarm Module is available for connection directly to an RIS's interface terminals. Single or multiple Alarm and RIS combinations are possible and are described in the Alarm Module Manual (2701-1982). Basic connection of an Alarm to an RIS is shown in that manual.

**2.9.4 RELAY ALARM INSTALLATION.** To install, follow the steps below:

**Disable** external warning systems controlled by the RIS and route additional cabling for the extra relay outputs that will be made available.

**Open** the RIS door and switch off the system at SW1. Disconnect the single relay output wiring from terminal strip J1 inside the RIS. Remove the black main board cover on the door rear to expose the option board slots.

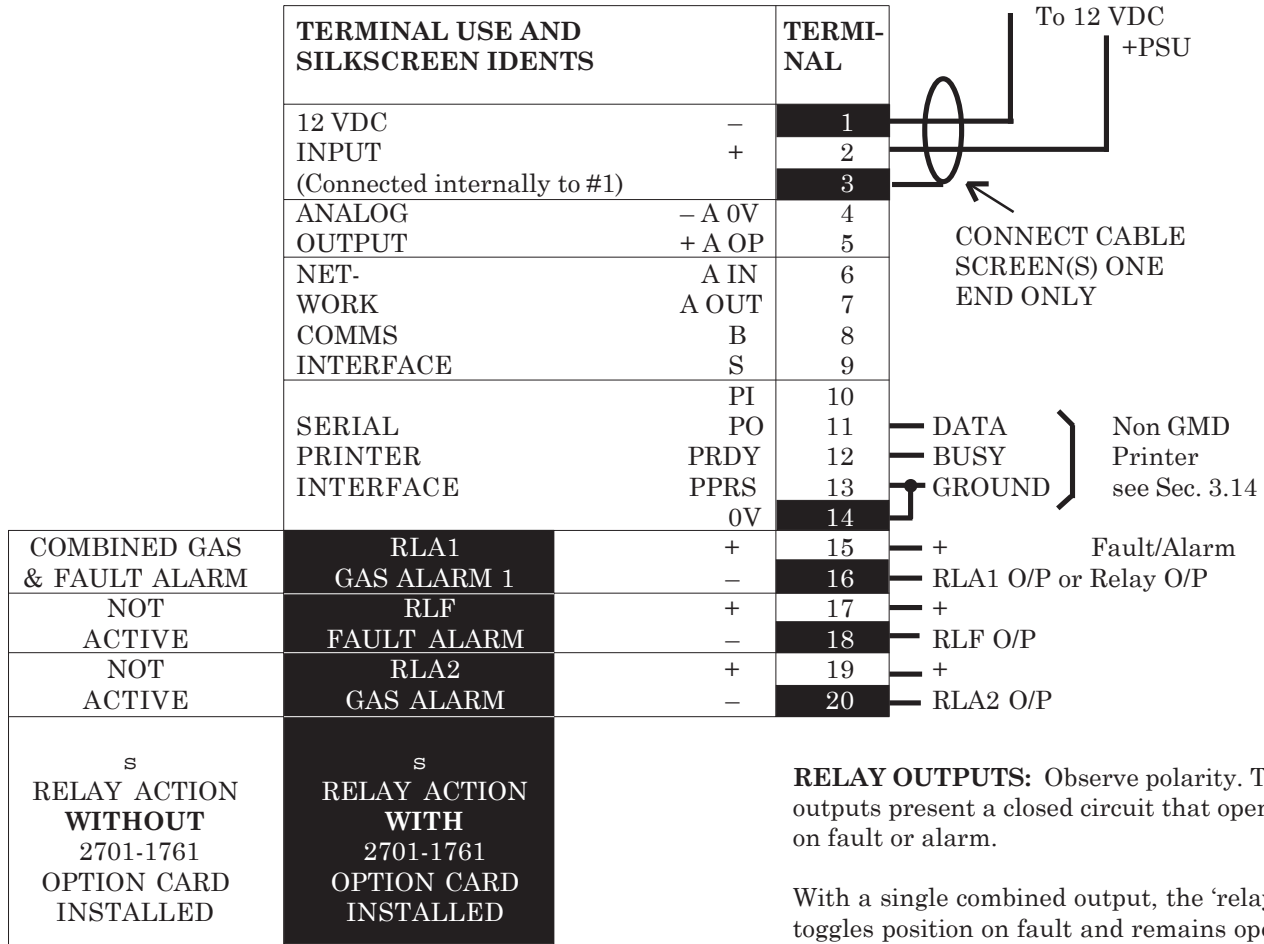
**Check** that the two EPROM's are Version 30-xx-03 or higher, where xx is the gas curve code (e.g. 00 for TDI, 06 for MDI etc.). 03 at the end of the version # confirms that the relays are normally closed in the 'off' state and open on alarm.

**Slide** the Relay Alarm Option board into a slot and engage the connectors. If the board is not put in correctly, the connectors will not mate. **When handling the option board wear a wrist strap with the clip grounded at RIS common.** Terminal # 1 on J1 can be used. If a wrist strap is not available, avoid touching components on the option board and the main board. Replace the cover on the main board.

Bring the new interface wires into the system and connect them according to the Figure 2-2.

Ensure correct polarity is observed. Switch the system on at SW1 and check for correct operation of the externally connected alarm system/s.

The gas alarms can be checked with the use of a Test Card, (see Section 3.13.3), or by opening the tape gate with the system operating.



**RELAY OUTPUTS:** Observe polarity. The outputs present a closed circuit that opens on fault or alarm.

With a single combined output, the 'relay' toggles position on fault and remains open on alarm. Adding the optional three-relay board option enables the three-relay option.

**GMD PRINTER:** When purchased as an option, the printer is usually plugged into the pre-wired external socket provided. Alternatively it can be hard-wired into the system through the J1 interface using the information provided in Section 3.14 of this manual.

**CURRENT RIS J1 INTERFACE CONNECTIONS WITH SYSTEMS USING VERSION 30-XX-03 AND HIGHER SOFTWARE.**

Figure 2-2. Hookup for Phase 2 Base Board Terminal Strip

TERMINAL USE AND SILKSCREEN IDENTS		TERM. #
12 V DC	-	1
INPUT	+	2
(To Terminal 1 Internally)		3
ANALOG	A 0V	4
OUTPUT	A OP	5
NET-	A IN	6
WORK	A OUT	7
COMMS	B	8
INTERFACE	S	9
	PI	10
SERIAL	PO	11
PRINTER	PRDY	12
INTERFACE	PPRS	13
	0V	14
RLA1	+	15
GAS ALARM 1	-	16
RLF	+	17
FAULT ALARM	-	18
RLA2	+	19
GAS ALARM 2	-	20

Figure 2-3. Phase 2 Base Board Terminal Strips

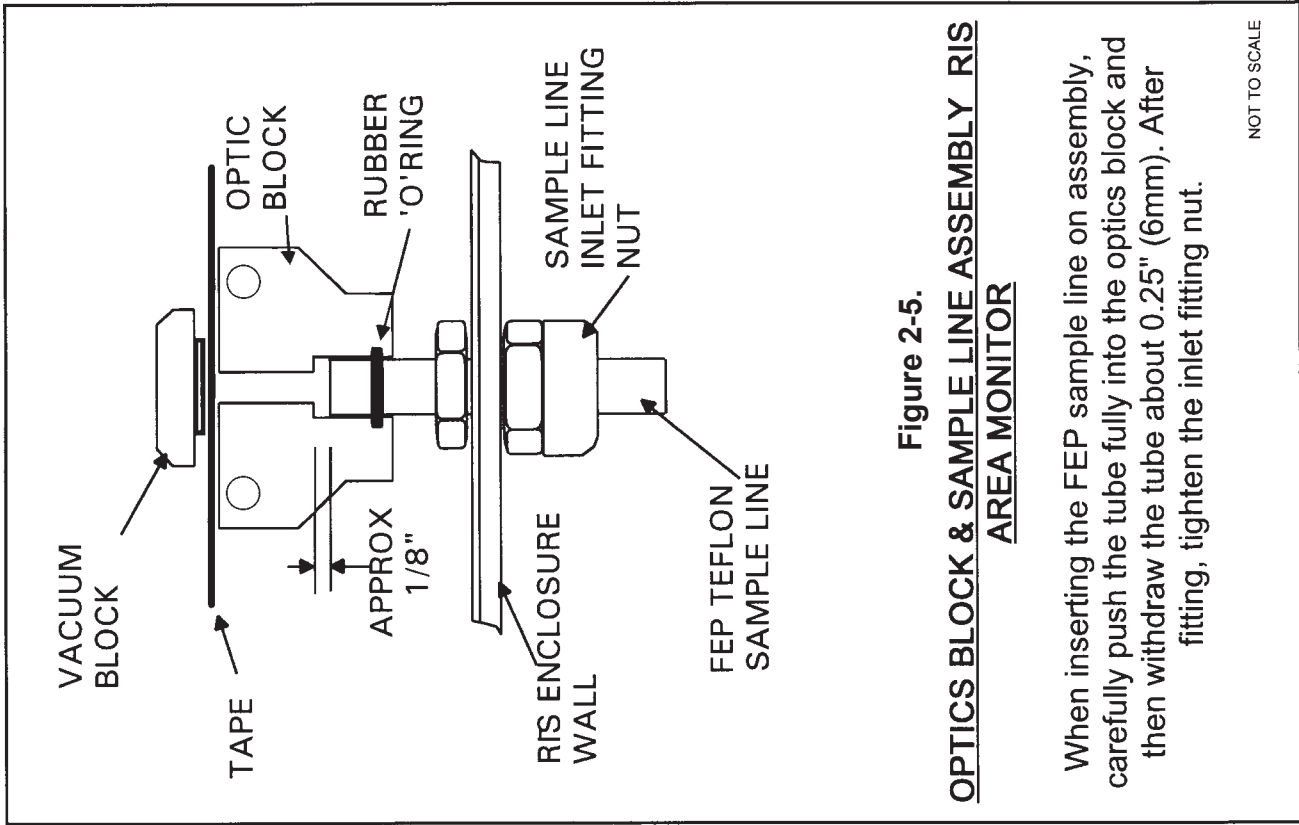


Figure 2-5.

**OPTICS BLOCK & SAMPLE LINE ASSEMBLY RIS AREA MONITOR**

When inserting the FEP sample line on assembly, carefully push the tube fully into the optics block and then withdraw the tube about 0.25" (6mm). After fitting, tighten the inlet fitting nut.

NOT TO SCALE

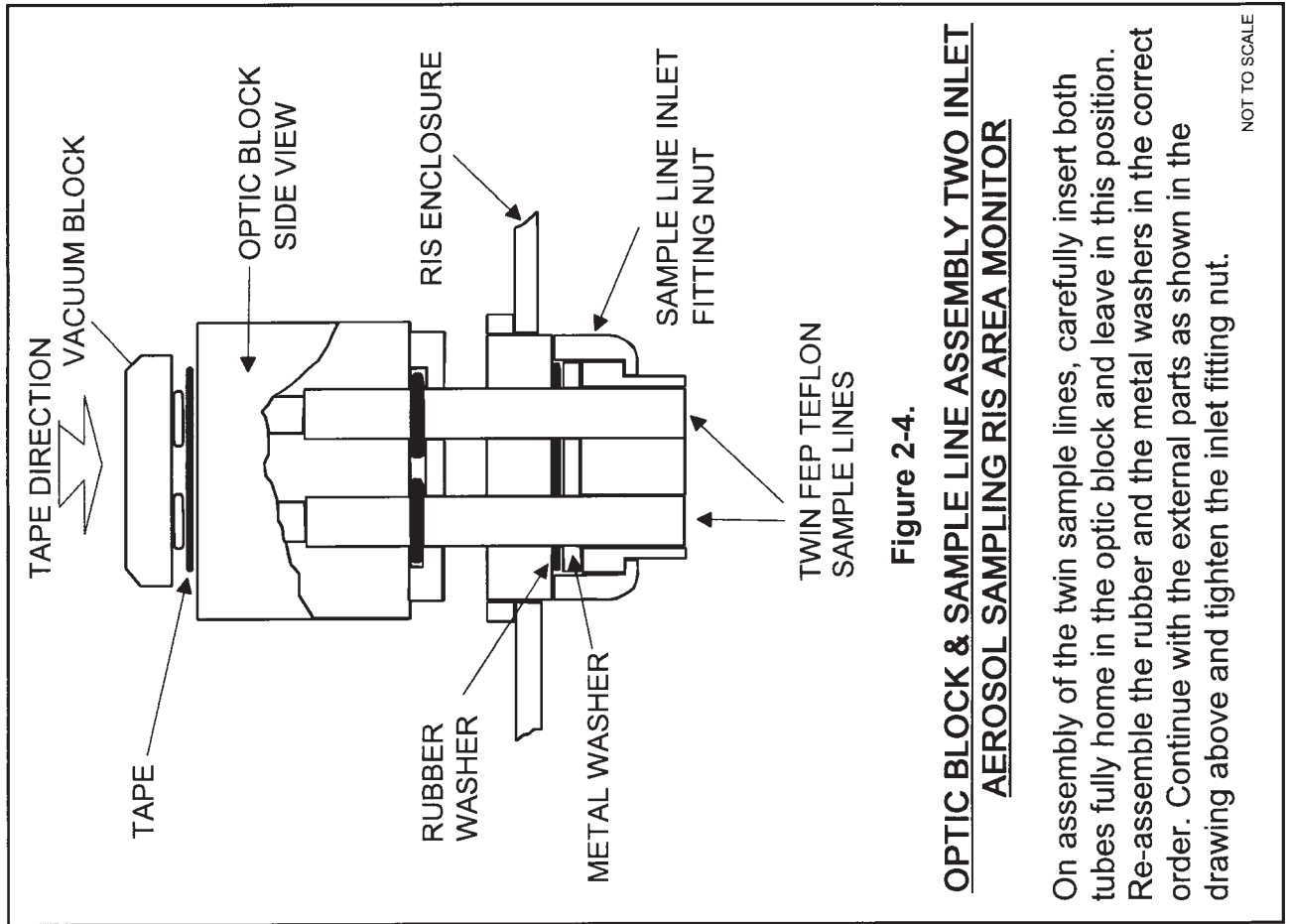


Figure 2-4.

**OPTIC BLOCK & SAMPLE LINE ASSEMBLY TWO INLET AEROSOL SAMPLING RIS AREA MONITOR**

On assembly of the twin sample lines, carefully insert both tubes fully home in the optic block and leave in this position. Re-assemble the rubber and the metal washers in the correct order. Continue with the external parts as shown in the drawing above and tighten the inlet fitting nut.

NOT TO SCALE



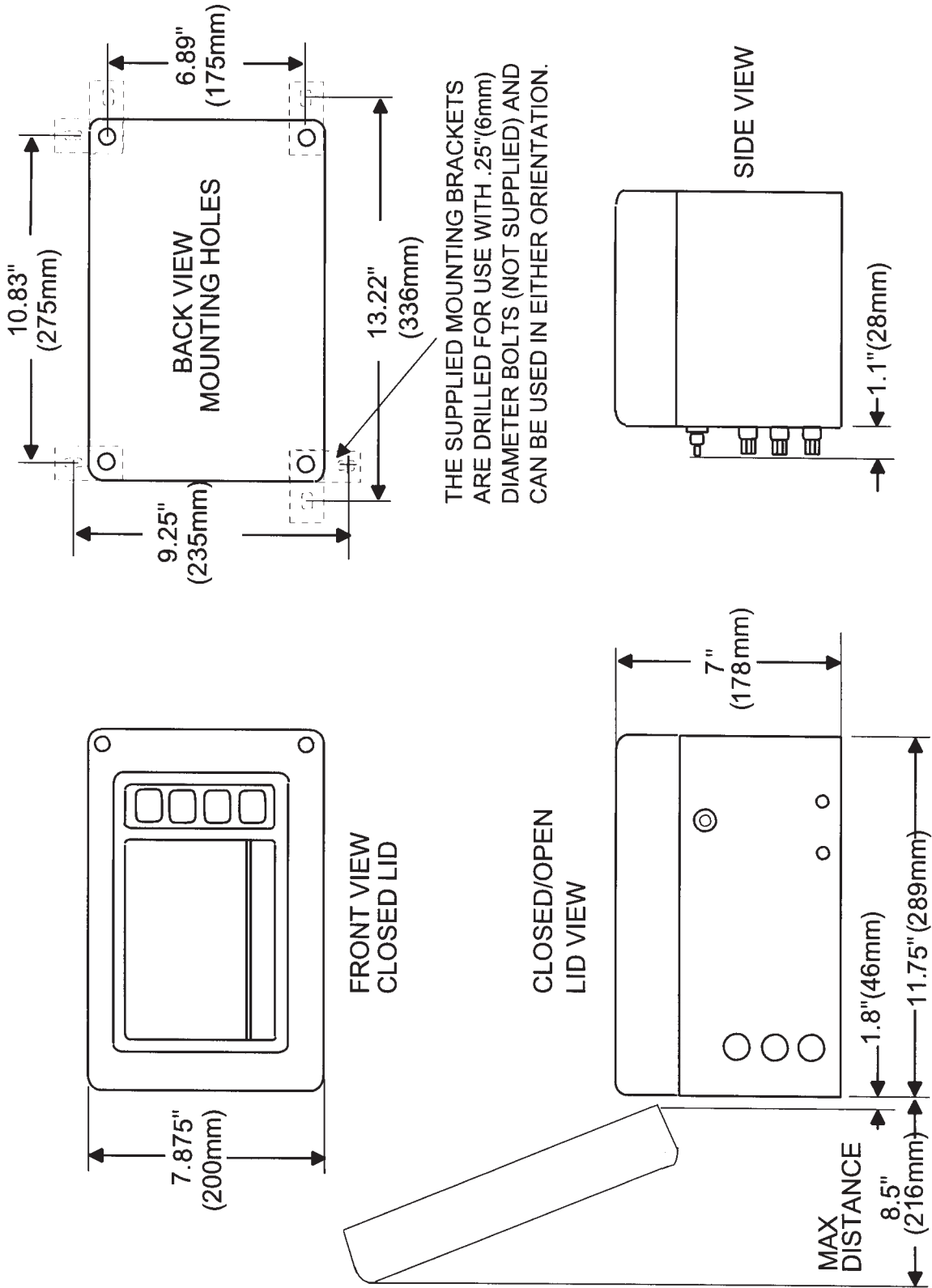


Figure 2-6. RIS AREA MONITOR ENCLOSURE & MOUNTING DIMENSIONS

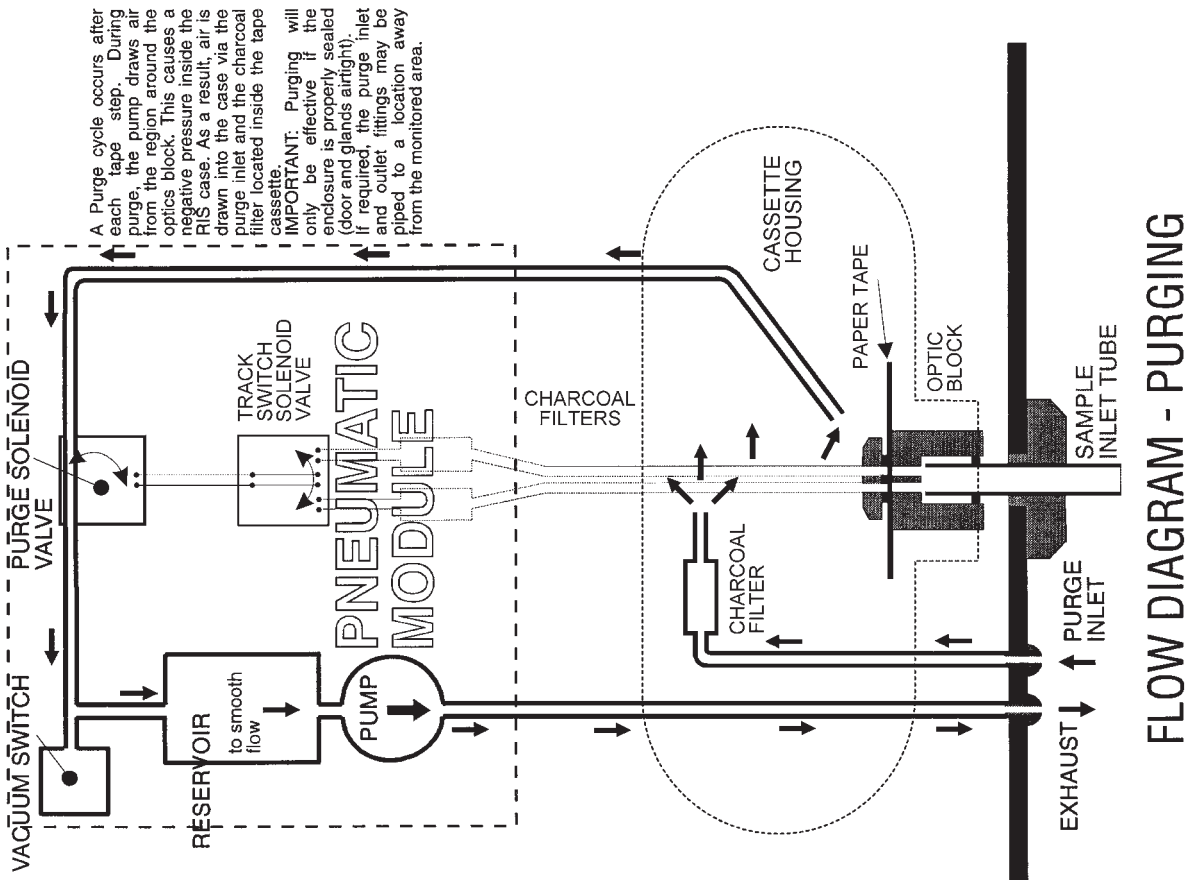


Figure 2-8

FLOW DIAGRAM - PURGING

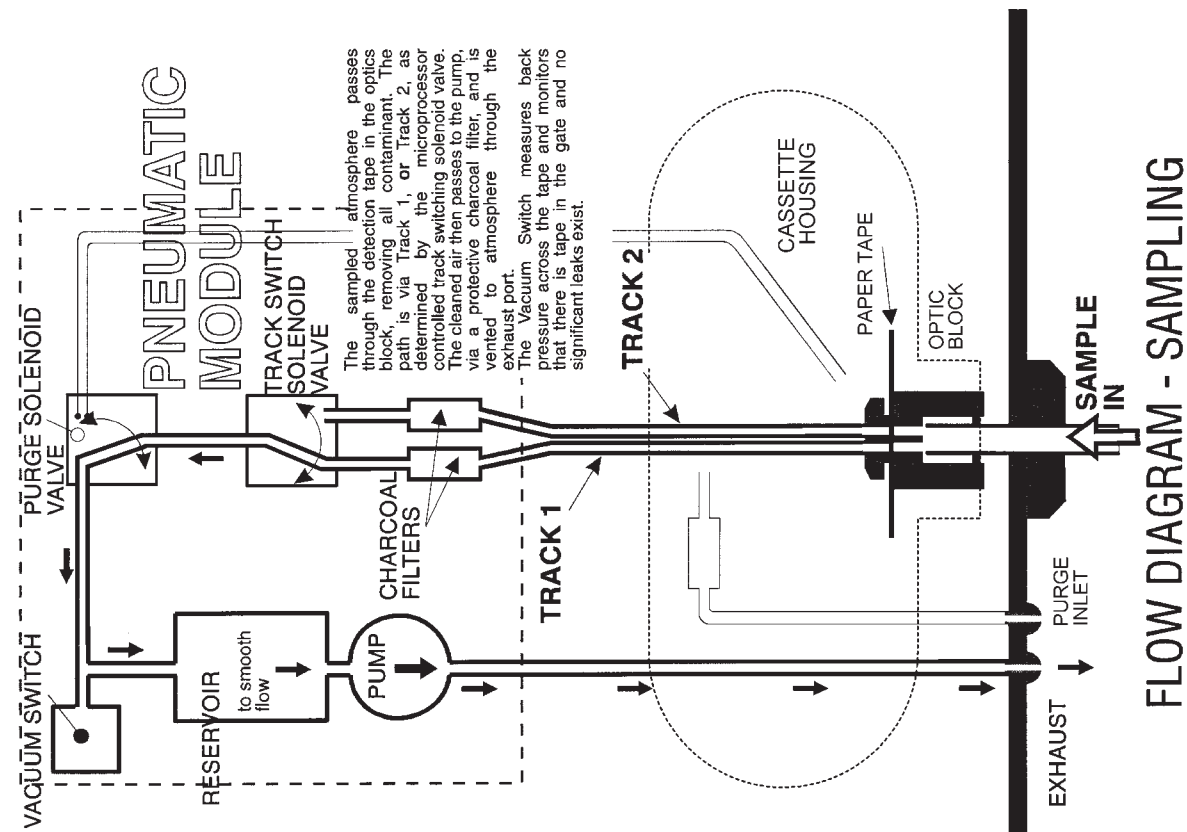


Figure 2-7

FLOW DIAGRAM - SAMPLING

### 3 SYSTEM OPERATION AND FEATURES

#### 3.1 COMPLETE SAMPLING SEQUENCE

The sequence starts with system and cassette being purged before gas sampling starts. In addition, a reference light level reading is taken from the fresh tape spot under the optics block.

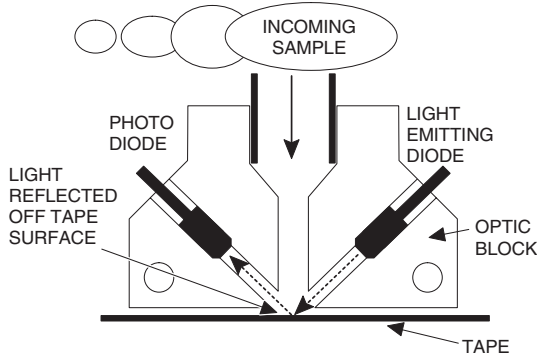


Figure 3-1. Sampling Sequence

During the sampling period the tape spot is scanned every two seconds. This frequent scanning detects the change in the reflected light value that occurs if a stain develops.

If no stain, or a low density stain, is detected, sampling continues for a fixed four minutes. At the end of this time calculated concentration for that cycle is displayed and the next cycle starts.

The development of a significant stain shortens the sampling cycle and the concentration value is displayed immediately, as described in more detail below.

When a concentration above alarm set point is detected, the gas alarm relay/s opens to initiate external alarm systems and warning devices. This is in addition to the visual warning display.

**3.1.1 AUTOMATIC PURGE CYCLE.** A purge sequence occurs after every tape step. The pump runs at a higher Flow Rate for 10 seconds; air inside the tape cassette, and the enclosure, is exchanged for filtered air. The incoming air is filtered as it passes through a 'scrubber' filter in the cassette. This is shown in the diagram in Figure 2-8.

Purging prevents the build up of gas in the system, and in the cassette where it could pre-expose the tape. The 'scrubber' filter is automatically renewed at each cassette change.

Effective purging requires the enclosure to be properly sealed. Ensure that the cable glands and the door are air tight. Unused cable glands can be tightened onto a short piece of cable.

Purge inlet and exhaust ports can be piped to a remote location, where this is necessary.

**3.1.2 TWIN TRACK TAPE SAMPLING.** At start-up the incoming sample is passed through the lower tape half (track 1). When that sampling period is complete, the microprocessor decides if a stain has formed on the tape. If not, the next sample is **again** passed through the same spot on track 1. Conversely if a stain **was** formed, the second sample is switched to pass through the upper half (track 2). The same sequence occurs at the end of that sample period and track 2 is reused if no stain is detected.

At this point the tape is stepped on and the next sample passed through the next track 1 spot. Figure 3-2 shows the sequence where no stain develops and the maximum of four sample periods occurs before the tape is stepped.

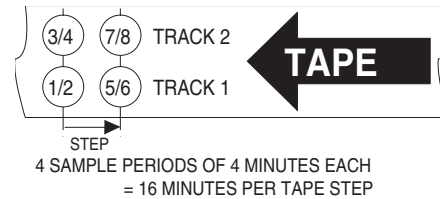


Figure 3-2. No Stain, Both Tracks Used Twice

Figure 3-3 shows that only two sample periods per tape step occur if significant stains develop on the tape.

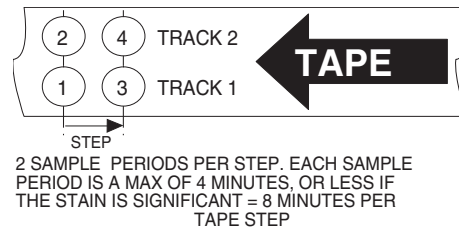


Figure 3-3. Stain On Tape, Both Tracks Used Once

**3.1.3 TAPE REFERENCE MEASUREMENT.** At the start of each sample period, the tape spot being used is scanned by the light pulse (generated by the optics system), see Figure 3-1. The value of the reflected light is measured and stored as the reference against which the light value, during and at the end of the sample period, is assessed..

This method eliminates the 'zero drift' that could otherwise occur with slight variation in the reflective value of the tape. It also ensures that system accuracy is not compromised when reusing the same tape spot. System accuracy is not compromised when reusing the same tape spot.

### 3.2 DENSITY & TIME OPERATING MODES

Actual sampling takes place under control of one of two operating modes. The microprocessor automatically selects the appropriate mode in relation to the dynamic situation being monitored. The two modes are:

**3.2.1 DENSITY MODE.** This operating mode is used when the sampled concentration is below a predetermined threshold. Under this condition, the gas sample period is a **fixed** four minutes.

During the four minutes, a sample is drawn into the system at a specified Flow Rate. The product of time and flow provides the measured volume used in the subsequent calculation of concentration.

The term 'Density Mode' is used because the sample volume is fixed and the variable used in the concentration calculation is stain **density**.

**3.2.2 TIME MODE.** When the concentration level of the sampled gas exceeds the preset threshold value, the stain on the tape develops quicker. By measuring the **time** it takes to reach the threshold density, it is possible to calculate the sample concentration.

Using the 'time mode' provides real benefits; a reading and an attendant alarm are provided rapidly when concentrations are high, and the tape is never allowed to become saturated. Because the tape doesn't saturate, the reaction is always in the linear region where the monitor's accuracy is maximized.

An additional benefit is that the tape continues to act as a filter and prevents the sample getting past the optics block and contaminating the system beyond.

### 3.3 CHANGE-OVER FROM DENSITY TO TIME MODE

With a 1,000 ppb instrument, the change-over from density to time mode occurs at 20 ppb. Other range instruments have change-over points in proportion. This dynamic control of sampling mode is automatic.

### 3.4 MINIMUM SAMPLE TIME

The minimum sample time in the time mode is approximately 16 seconds. This response occurs when the monitored concentration has reached, or exceeded, the maximum range of the instrument.

### 3.5 TAPE CASSETTE LIFE

The cassette has a nominal life of 30 days. However the rate at which the system uses tape, and the consequent cassette life is dependent mainly on the gas concentration monitored.

If the level is zero, or very low, a tape step will occur every 16 minutes (4 x four minutes). This is because the two tracks are each used for two consecutive samples of four minutes as explained in Section 3.1.2.

If the monitored concentration is higher, the tape steps every two sample periods; also the sample period itself can reduce below 4 minutes (dependent upon the concentration reached). A tape step will therefore occur at least every 8 minutes (2 x 4 minute sample periods) and more quickly if levels are high.

*Infrequent* high gas concentrations will not have much effect on cassette life, but if monitored levels are continuously significant, cassette life will be noticeably reduced.

In most applications, since monitoring is being done to confirm an expected zero, or very low gas concentration, cassette life will be close to the 30-day period specified.

### 3.6 DATA POINT STORAGE

At the end of each sample interval the calculated data point is stored, as are the calculated TWA's. The 15 minute TWA, and the 8 hour TWA are both available for immediate display at a touch of the appropriate front panel key switch. The stored data points can be printed out as a record when the optional Printer option is fitted.

### 3.7 SYSTEM DISPLAY

The displayed information, including symbols, or icons, depends upon the operating conditions. These and related information are as described below.

**3.7.1 SYSTEM NORMAL, GAS CONCENTRATION ZERO OR LOW.** This is the usual operating condition and three pieces of information are displayed.

**SYSTEM OK** icon confirms the system is operating normally.

**NUMERICAL VALUE** (in **ppb** or **ppm**) alternates with % value of remaining cassette life. When cassette is new the display reads 99%. As the tape is used, the numerical value reduces in proportion.


**NOTE:** *If the system is turned off and then on at SW1, or if the tape reset button is used, the tape counter is reset to 99%. This occurs despite the actual tape remaining.*


**3.7.2 SYSTEM NORMAL, GAS CONCENTRATION ABOVE THE ALARM THRESHOLD.**


Besides the **SYSTEM OK** and the **NUMERICAL VALUE** of the measured concentration, a '**FLASHING BELLS**' icon is shown across the top of the display. This provides a strong visual warning that a Gas Alarm is present. The display is maintained during the period that the threshold level is exceeded *and until a complete sample period has passed where the concentration falls below the alarm level.*


**3.7.3 OVER RANGE ALARM.** When the monitored concentration exceed the system range, the 'flashing bells' icon is accompanied by the numerical readout displaying 9999 (ppb models) or 99.99 (ppm models).


**3.7.4 SYSTEM FAULT.** When self diagnostics detect a fault condition, the **SYSTEM OK** icon is turned **off** and one or more fault icons are displayed. Icons and their meaning are as follows:

**Constant**  
 This symbol shows that the input supply has failed, or is not connected, and the system is operating from the internal back-up battery.


**Flashing**  
 Shows that the back-up battery charge is low. This could occur with long interruption of input power. It can also warn that the battery is not maintaining an adequate charge during **NORMAL** operation.

**Constant**  
 Warns that the cassette has run out of tape, or the tape has broken, or the tape gate has been left open.

**Flashing**  
 This symbol shows that sampling vacuum has dropped. The cause could be a pump failure or an air leak.

**Optics**  
 Icon warns that the light level is not acceptable. In addition, the affected channel is shown by a 1 or 2, or both.

**NOTE:** *This will occur if the tape gate is opened, an external light source enters the sampling input FET tube(s), the tape breaks, runs out, or, if the cassette is changed without first going into the **TEST Mode.***

**Door Open**  
 This icon is displayed when the system door is open. It is also shown if the 'door closed switch is incorrectly adjusted or if the door securing screws are not tight, **be careful not to over tighten them!** The switch adjustment procedure is detailed in Section 4.7.

**3.8 SYSTEM ALARMS**

The standard RIS provides displays of gas and fault alarms, and a combined 'relay' output. Basic systems have one gas alarm set point with a default value established by the system software. The alarm set point is also user adjustable through the RIS keyboard so that it can be set to an appropriate local value. Set point adjustment is covered in Section 2.8.2.3. The default values are shown in the Table #1.

A fault alarm is initiated by any one of several monitored parameters. Appropriate icons are shown on the display when a fault is detected.

**3.8.1 GAS ALARM.** When a gas concentration value above the alarm set point is detected, the 'flashing bells' icon provides visual warning. Simultaneously the combined gas alarm/fault relay opens. Both warnings, visual and relay signal, remains active until a gas concentration lower than the set point is measured over a complete sampling cycle (normally 4 min.). This ensures that small variations around the set point do not cause intermittent alarm operation.

**3.8.3 ADDITIONAL GAS ALARM SET POINT.** When the Relay alarm Option is installed, a second alarm level set point is provided. This second set point is also user adjustable. In this case there are three active relays, one for each alarm level, and one for fault indication.

**3.8.3 FAULT RELAY.** With the basic system the single (combined) gas alarm/fault relay is operated to provide external warning of any of the monitored 'fault' conditions. In a fault condition, the relay output 'toggles' open and closed at 1 Hz. When the Relay alarm Option is fitted, a separate relay output is provided which opens and remains open when a fault is detected. The fault icon and the relay output remain active until the fault condition is cleared.

### 3.9 DIAGNOSTICS

Key system parameters are constantly monitored during normal operation. If any parameters fall outside acceptable values, a system fault condition is initiated and the appropriate display and relay output warnings are given. Each monitored condition, and the icon used on the display in warning, is detailed in Section 3.7.

#### 3.10 TEST MODE

The TEST Mode is provided to allow users to quickly check key system parameters. This helps to ensure the system is always operating in optimum, trouble-free conditions.

It is recommended that the system parameters are checked, and recorded, at each cassette change. Section 2.8.2 explains this and how to use the TEST Mode. A record sheet is included at the end of the manual.

#### 3.11 KEYPAD FUNCTION

Use of four keys, and the mode in which each is active, is as follows:

**3.11.1 'HOLD/RELEASE' KEY.** This is a toggle. It is used to hold the displayed data/function for observation or adjustment. The display 'holds' for 5 minutes unless released by a second key press. This key operates in both Normal and TEST Mode.

**3.11.2 'PRINT' KEY.** This has two functions.  
**Normal Mode.** The key is pressed to download the data stored in the (optional) printer card memory to the printer.  
**TEST Mode.** The key is used to clear the printer card memory (if one is fitted).

**3.11.3 '15 MIN TWA (DECADE)' KEY.** There are two functions:  
**Normal Mode.** Operation of the key displays the TWA for the preceding 15 minutes, (or 10 minutes, if this option is applicable).

**TEST Mode.** The switch is used to select the required decade when setting programmable values (For instance, when changing the alarm level/s or setting the date/time with the printer option fitted).

**3.11.4 '8 HR TWA (DIGIT SET)' key.** Again the function depends upon the operating mode.

**Normal Mode.** Pressing the key initiates the TWA display for the preceding 8 hours.

**TEST Mode.** The key is used, together with the decade select key, to select required digit.

### 3.12 USING THE KEYBOARD

The switches used in the keyboard are of a rugged sealed membrane type. To ensure positive operation of the key switches, press **firmly**.

### 3.13 OPTIONAL FEATURES

Several optional features are available to extend the capability of the standard RIS. These options are:

**3.13.1 RELAY ALARM OPTION.** This can be user-retrofitted. The option provides two separate alarm relay outputs. Each has a user-adjustable set point. In addition, a separate fault relay is provided. The option is available for all current RIS systems with phase 2 base boards and requires the fitting of an additional circuit board in an already provided slot.

**3.13.2 PRINTER INTERFACE OPTION.** Can be user-retrofitted. The option provides data storage for up to 7 days of data points, a clock function and printer control circuitry. When this option board is fitted, an external printer can be plugged into the pre-wired port; or hard wired to the system interface. Option board is fitted into an already provided slot.

The printer circuit board is fitted with DIP switches to allow selection of the interval at which data points are printed. Each data point can be printed as it is calculated, or at intervals from 30 minutes to 24 hours. Printing 'on demand', whenever the RIS control panel PRINTER key is pressed is also available.

In addition to the time and value of data points, a header is printed with TWA's, system current and voltage.

**3.13.3 TEST CARD.** The following shows how to simulate a gas alarm and enable the operation of external alarm systems to be checked.

**IMPORTANT:** Please note that this method is not suitable for, and is not intended to be used for, checking or verifying the system's calibration, but only for alarm simulation and checks.

**Test Preparation.** Warn that tests are to be carried out and that external alarm systems may be activated. Check that the RIS is powered up and working. Open the door and disable the door open switch with a magnet. (A suitable magnet is available, see Chapter 5). It may be convenient in some cases to remove the board cover.

**Enter TEST Mode** (press the Red button on the main board), open the tape gate and remove the cassette. Insert the Test Card in the gate with the zero line on the card lined up with the edge of the optics block. See Figure 3-4. Close the gate.

**NOTE:** Due to the reflectance difference between the cassette tape and the Test Card, it may be necessary to readjust the light level of track 1 to 220 with the Test Card installed in the tape gate. Refer to Section 4.4 (Adjusting Light Levels) for instructions. It is not necessary to adjust track 2 for this test.

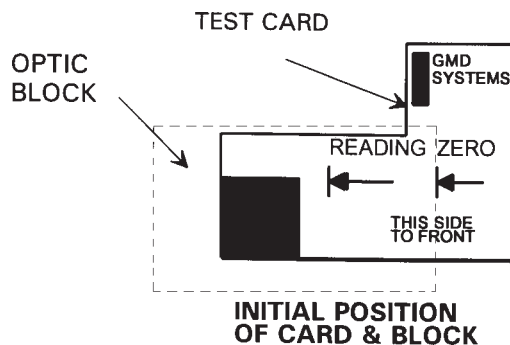


Figure 3-4. Installing Test Card

**Exit TEST Mode,** leaving test card in gate.

**Carrying out the Test.** Press the Tape Reset button (the red button on the left of the optics block). The tape advance cam will turn (but will not move the test card), and a cycle commences. The purge cycle will start, listen for the cycle to end 10 seconds after it starts, (the pump sound will reduce as the pump slows). Start Counting when the purge cycle stops and the normal sampling cycle starts. **After 20 seconds pull test card to the right** so that the READING mark is lined up with the right side of the block, Figure 3-5.

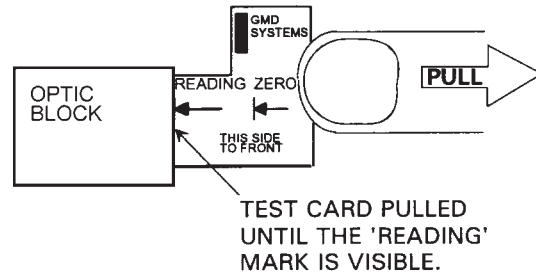


Figure 3-5. Pulling Test Card

This puts the dark 'stained' section of the card under the photo cell. The result should be an immediate 'gas concentration' of, typically, 40 to 60% of full range shown on the display (i.e. approximately 400 to 600 ppb for a 1,000 ppb RIS).

**NOTE:** The actual reading is not important if it is above alarm set point.

**If the 20 seconds is reduced,** the concentration reading will be higher. Conversely if it is increased the concentration will be lower.

**NOTE:** Be aware that a fault alarm will, usually, inhibit a gas alarm; make sure that there isn't a fault condition active when test is started.

The test card check can be repeated by opening the gate, repositioning the test card, pressing the tape reset button and starting again.

**IMPORTANT:** AFTER CHECKS have been completed, enter the TEST Mode, remove the test card, and replace the cassette. Reset the light level of track 1 to 220 if changed. Remove the magnet used to inhibit the door open alarm and replace the cover on the main board, (if this was removed). Put the RIS back into service.

### 3.14. PRINTER OPERATION & USE (OPTIONAL FEATURE)

**3.14.1 GENERAL.** The Printer option requires fitting of the Printer Option board and connection of a suitable Printer. See Chapter 5 for part numbers.

Installation of Printer Option board is described in Section 2.9.1. Methods of connecting a suitable printer are described below.

In addition to that supplied by GMD, printers meeting the specification detailed below may be used. Those intending to use an alternative printer should check the specification carefully.

**3.14.2 PRINTER SPECIFICATION.** The printer must be capable of receiving serial data and meet the following requirements:

- Baud Rate: 600, 1200, 2400, or 9600 bits/sec.
- Stop Bits: 2 bits
- Word length: 8 bits Parity:
- Even Signal Level: TTL Logic Type: Positive

**3.14.3 PRINTOUT MODES.** Three modes of printer operation are provided. They are:

**Print ‘On Line’.** In this mode each data point is automatically printed as it is generated.

**Print at Intervals.** The data is stored and printed out at predetermined intervals. The interval is user selected.

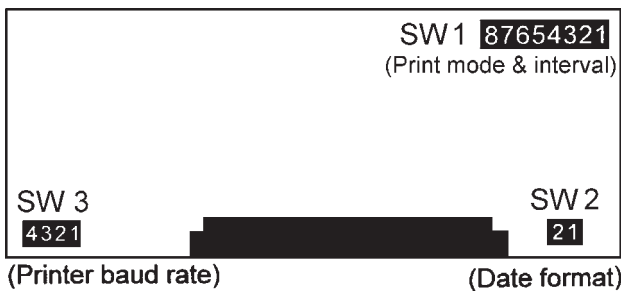
**Print on Command.** Data points are stored until the PRINT key is pressed. Up to 7 day’s worth of data can be stored for print out when commanded.

In each of the above printer modes, the storage is cleared when the data is printed out.

If necessary, printer storage can be cleared at any time as described in Section 4.9.

**3.14.3.1 Printing ‘On Line’** (printing every data point as it is calculated). Select by setting:

**Switch # 1 of SW1** switch bank on the Printer Module to ‘OFF’ and set switches 2 to 8 to ‘ON’. See Figure 3-6 for switch location.



**Figure 3-6. Switches 2 & 3**

**Initial printout** in this mode includes: date, time, tape left %, battery volts, battery charge (total system current in mA), alarm level and the monitored gas concentration. Also shown are gas or fault alarms, if these occur.

**Subsequent printouts** show only the time and concentration, unless there is a system fault or an alarm present.

Where it occurs, gas alarm, or type of fault detected, is printed out next to the time and concentration.

**3.14.3.2 Print at Intervals.** Select by setting:

**Switch # 1 of SW1** switch bank on the **Printer Module** to ‘ON’. See Figure 3-6 for switch location.

Printing intervals are available in 30 minute increments **up to 24 hours**. Intervals are set with SW1 switches # 3 to # 8, as follows.

Switch # 3 to # 8 each enable a discrete period of time when turned ‘OFF’. Each enabled switch adds its time value to achieve the total required. The value of each switch when ‘OFF’ is:

- Switch # 8 = 30 minutes
- Switch # 7 = 1 hour
- Switch # 6 = 2 hours
- Switch # 5 = 4 hours
- Switch # 4 = 8 hours
- Switch # 3 = 16 hours

**Switch # 2 is not used and is left ‘ON’**

**Examples:** For print intervals of 6, 12 and 24 hours, SW1 switches would be set as follows:

SW1	#8	#7	#6	#5	#4	#3	#1	TOTAL
Time	on 0	on 0	off 2	off 4	on 0	on 0	on --	= 6 hour
Time	on 0	on 0	on 0	off 4	off 8	on 0	on --	= 12 hour
Time	on 0	on 0	on 0	on 0	off 8	off 16	on --	= 24 hour

Any combination of the switches can be used to select an interval **up to 24 hours**.

**Printout:** A full printout of all measured parameters occurs at each interval.

**3.14.3.3 Print on Command.** Select by setting:

**All switches (# 1 to # 8) of SW1** switch bank on the **Printer Module** to ‘ON’. See Figure 3-6 for switch location.

The printout is initiated when the PRINT key on the RIS front panel is pressed. The entire stored data points are printed out.

Data is not lost if the PRINT key is inadvertently pressed without a printer connected.

**Printout:** A full printout of all measured parameters occurs at each printing occurrence.



**3.14.3.4 Printed Date Format.** A choice of month/day or day/month format is available:

For the US **month/day/year** format, set **SW2 switches 1 and 2 'ON'**.

For the European **day/month/year** format, set **SW2 switches 1 and 2 'OFF'**.

**3.14.3.5 Data Storage Up To 7 Days.** In any of the selected modes, data can be stored for later printout (up to 7 days of data). This is simply achieved by unplugging the printer connector at the RIS printer socket. When a printout is required, plug in the printer connector, switch the printer on and then press the PRINT key on the RIS front panel.

**3.14.3.6 Preventing Data Loss. Data will be lost if a printer is connected to the RIS but not Switched on.** Under these conditions, the RIS attempts to 'dump' data at the selected interval and clears the data memory, even though no physical printout is produced due to the printer being switched off. To prevent this from occurring, whenever the printer is not in use, always disconnect it, by its connector, **at the RIS**.

**3.14.4 PRINTER CARD DESCRIPTION.** In addition to the switch functions already described, the printer card provides the following function and facilities.

**3.14.4.1 Real Time Clock.** Enables data to be stored with relevant time and date reference. The clock is not separately supported and if the system switch SW1 is turned off it must be reset after the switch is turned on.

The clock is set by use of the front panel key switches, using the procedure described in Section 2.8.2.9.

**3.14.4.2 Data Storage.** Capacity for storing up to 7 day's worth of data points is provided. The stored data always contains the most recent record. When full, the oldest data points are deleted allowing space for the new data. Once the printer card is installed, the storage of data takes place automatically.

When the stored data has been printed under preset timed control, or a PRINT command from the keyboard, the microprocessor clears the stored data. The storage can also be cleared at any time by using the procedure in Section 4.9.

**3.14.4.3 Data Communication.** The printer interface card communicates with the microprocessor through a data buffer. Connecting a printer to the printer port completes a circuit that links the printer present line (PPRS) to ground (0 V).

This makes the microprocessor aware that a printer is connected. The microprocessor then writes each data point to memory locations on the board.

Once stored, the data is retained until it is printed out, or deleted to make way for current data, or when cleared under keyboard control.

Data is transferred at a higher rate than the printer is able to print. Flow of data is therefore controlled by the printer ready line (PRDY) which changes state to enable, stop, or transfer as required.

**3.14.4.4 Selection of Printer Baud Rate.** The Bacharach Printer has a baud rate of 600 bits/sec. and printer option board has SW3 switches set with switch # 4 'ON' and the other 3 switches 'OFF'.

The settings for the complete baud rate selection are:

BAUD	SW # 4	SW # 3	SW # 2	SW # 1
600	ON	OFF	OFF	OFF
1,200	OFF	ON	OFF	OFF
2,400	OFF	OFF	ON	OFF
9,600	OFF	OFF	OFF	ON

**3.14.5 CONNECTING A PRINTER.** A printer can be connected permanently, or plugged in when required. In the latter case, one printer can be used to support a number of RIS systems.

**3.14.5.1 GMD Printer Connection.** The GMD printer is supplied complete with an interconnecting lead that enables the printer to be plugged into the standard, pre-wired, socket provided on the left side of the RIS.

If required, the printer can be permanently wired to the RIS interface by removing the plug from the cable and connecting it into the J1 interface in accordance with the information provided in the table below.

Printer Cable Wire Color	Connect to J1 Terminal #	Signal Identification
Not used	10	PI
WHITE	11	PO
RED	12	PRDY
BLACK	13	PPRS
BLACK	14	0 V

First, turn off the RIS at the system power switch SW1. Then feed the cable into the RIS through a convenient cable gland. Carefully tighten the gland around the cable to preserve enclosure sealing.

After the cable has been connected and checked, switch the system back on and test the printer operation. This is most conveniently done by setting the # 1 switch on SW1 of the printer option board to 'OFF'. This will cause each data point to be printed as it is stored.

**3.14.5.2 Connecting a Non-GMD Printer.** First verify that the printer meets the specification detailed in Section 3.14.2.

Check the printer manual and identify the wire color, or pin number, on the printer cable that corresponds to **BUSY, DATA and GROUND**. If only the pin numbers are given, open the plug on the end of the printer cable and write down the wire color that corresponds. The plug can then be cut off and the wire ends prepared for connection to the RIS interface J1. Cut off any unused wires in the printer cable.

After turning off the RIS power switch SW1, feed the cable through a cable gland and connect the prepared printer cable as in Figure 3-7.

If the printer cable is screened, ensure that the screen is grounded **at one end only**.

When connections have been made and checked, tighten the cable gland, turn the system on at SW1 and test the print operation.

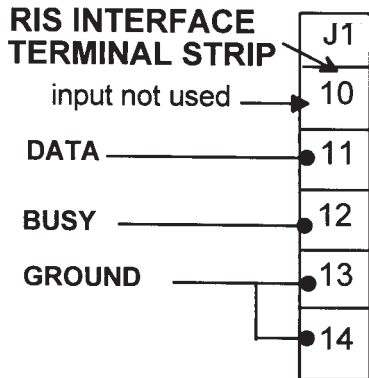
The plug can then be cut off and the wire ends prepared for termination in a plug that will mate with that fitted on the RIS.

The plug should be connected in accordance with the following table.

Plug Pin #	Connect to:
1 to 3	No connection
4	DATA
5	BUSY
6	GROUND
7	Link to pin 6

If the printer cable is screened, ensure that the screen is grounded **at one end only**.

When connections have been made and checked, plug the printer into the RIS and check operation. Refer to Section 3.16.3 for details of the available printout modes.



**Figure 3-7 Non-Bacharach Printer Interface**

**3.14.5.3 Portable Use of a Non-GMD Printer.** First verify that the printer meets the specification detailed in Section 3.14.2.

Check the printer manual and identify the wire color, or pin number, on the printer cable that correspond to **BUSY, DATA and GROUND**. If only the pin numbers are given, open the plug on the end of the printer cable and write down the wire color that corresponds.

## 4 MAINTENANCE AND TROUBLESHOOTING

### 4.1 MAINTENANCE GENERAL

Under normal circumstances, recommended routine maintenance consists of cleaning the exterior of the enclosure, carrying out a check of key parameters, and checking certain parts for mechanical tightness. In addition, occasional cleaning of the input path and optics block may be required under adverse sampling conditions. Each of these procedures is dealt with below.

**NOTE:** *Most procedures require the unit to be in TEST Mode. To enter TEST Mode see Section 2.8.2.*

### 4.2 VERIFYING THAT A GAS ALARM WAS CAUSED BY GAS

In situations where the gas level monitored is continuously zero and an alarm occurs, there may be a tendency to assume that a system 'fault' is responsible. Under these circumstances first assume the alarm is genuine and take appropriate action. The presence of gas is easily verified.

Put the system into the TEST Mode and remove the cassette. Examine the tape in the gate area and toward the take up spool. The presence of a circular stain, or succession of stains, will verify that gas has been sampled. The nature of the stains will show the level of exposure as follows:

A faint stain, or succession of faint stains increasing in density, suggests an initially low concentration that is slowly increasing. As monitoring continued, the stain density would diminish as the contamination dispersed.

If the stains are intense, or become so quickly, and then remain at the same high density, a significant concentration has been sampled. (The constant, dense stains, show that the system was operating in the 'time mode' which only occurs at higher concentrations. See Section 3.2.2).

### 4.3 CLEARING A SPURIOUS ALARM

If the tape gate is opened without putting the system into the TEST Mode, an 'alarm' may be initiated. It is also likely that a 'light fault' will occur. To clear these conditions:

**Open** the door (if it had been closed), and enter the TEST Mode. Ensure that there is a cassette mounted and that tape is in the gate which should be closed.

Allow the Test data to cycle to the light level value (track 1), HOLD the display and check that the reading is near 220. RELEASE the track 1 display and then HOLD to check track 2. RELEASE track 2 and again press the TEST Mode button to return to the NORMAL mode.

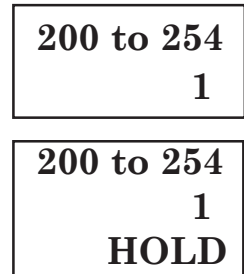
The light fault will now be clear and the only fault icon displayed should be the 'door open' symbol. The 'Flashing Bells' and the numeric display will remain until the end of the current four minute sampling period (which commenced on the exit from the TEST Mode).

### 4.4 ADJUSTING LIGHT LEVELS

RIS's manufactured before April 1992 have adjustment potentiometers **under** the tape cassette which has to be removed before light levels can be adjusted (see Supplement A ). This is not necessary for the adjustment on units made after April '92, which is shown below:

Install the tape cassette if not present. Light levels can only be adjusted with the cassette installed.

Enter the TEST Mode by pressing the red button on the back of the door. Wait until the display has cycled to show:

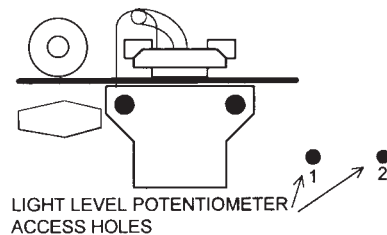


Press the HOLD/RELEASE button on the front panel firmly so that the display shows:

**Figure 4-1. Entering TEST Mode**

This display status will be maintained for 5 minutes, or until the HOLD/RELEASE button is pressed again.

Adjustment is made by means of the two potentiometers that are located beside the tape head and accessed through holes in the top plate. The light level track 1 is adjusted by one, and track 2 by the other. The potentiometer access holes in Figure 4-2.



**Figure 4-2. Light Level Access Holes**

With the tape in place, adjust the track 1 potentiometer until the reading is 220. **Clockwise** rotation of potentiometers **increases** the level.

**When track 1** has been adjusted, press the HOLD/RELEASE button to allow track 2 to be displayed. HOLD this display as before and adjust track 2 in the same manor as track 1.

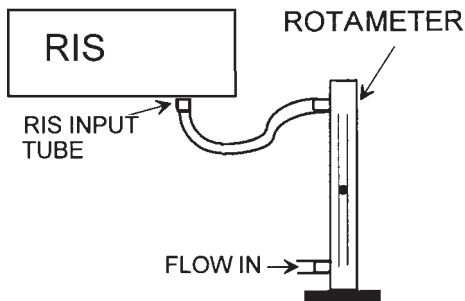
**After adjustments** exit the TEST Mode by pressing the red button on the rear of the door again, unless other tests have to be done.

Exit the TEST Mode by pressing the red button on the rear of the door again, unless other tests have to be done.

#### 4.5 CHECKING AND ADJUSTING SYSTEM FLOW RATE

REFER to Table #1 to check the correct Flow Rate for your system.

Connect a suitable flow meter in series with the RIS input tube as shown in Figure 4-3. A bubble meter or a rotameter (flow meter) with an accuracy of  $\pm 5\%$  FSD is recommended. Ensure that the flow meter is vertical or the subsequent reading will not be accurate. Connection to the RIS input tube must fit tight and not allow any leakage.



**Figure 4-3. Flow Rate Hookup**

**Enter** the TEST Mode and HOLD display at Light Level 1 by pressing the HOLD/RELEASE key. At this point the pump is running at NORMAL sampling rate. Ensure there is tape in the gate, and that the gate is closed. Take a reading of the track 1 flow and record it for reference.

If the flow is not at the specified rate, it should be adjusted using the Flow Adjust POT which is located on the main circuit board on the back of the door (See the Figure 1-2 for the location). It is not necessary to remove the protective cover over the board to adjust this POT.

After the track 1 flow has been adjusted, press the HOLD/RELEASE key. Allow the display to cycle to track 2 and press the HOLD/RELEASE key again to enable the track 2 flow to be checked. Because the flow has already been adjusted on track 1, the flow should also be correct on track 2.

If there is a difference between the two track Flow Rates of more than about  $\pm 5\%$ , the difference should be investigated and corrected.

**NOTE:** Porosity of the tape can vary a little along the tape, and from tape to tape. This factor may cause small changes in the Flow Rate but the effect is not significant. Don't over-adjust this parameter.

Having set the correct Flow Rate, exit the TEST Mode by pressing the red button.

#### 4.6 DISABLING THE 'DOOR OPEN' ALARM

If the 'door open' fault alarm is inconvenient when working with the door open, or it is necessary to turn off the switch, it may be temporarily disabled as follows.

**Hold** a small magnet (see Section 5.5) close to the semiconductor switch mounted in the bottom left-hand corner of the main board. The polarity must be correct, so if it doesn't work the first time, turn it around to reverse the polarity. **Take care not to damage the switch!**

#### 4.7 ADJUSTING THE DOOR SWITCH

A correctly adjusted 'door open' switch will turn the door alarm off as the door is tightened against its seal.

There are two parts to the switch; a 'hall effect' semiconductor mounted on the main board in the door, and a magnet on an adjusting pillar located in the enclosure corner. As the door is closed, the switch and the magnet are brought into proximity and the switch changes from 'open' to 'closed'. If adjustment is required, use the following method:

Open the RIS door and locate the door switch magnet mounting pillar in the bottom right-hand corner of the enclosure. Refer to Figure 1-2 for the position of the magnet. Loosen the lock nut with a 5/16" wrench so that the distance between the magnet and the hall effect switch 'sensor', can be changed.

**If the door fault does not go off** when the door is closed and the fixing screws are tightened moderately, **unscrew** the magnet mounting pillar a little. This will bring the magnet **closer** to the hall effect switch when the door is closed and will make the switch operate earlier.

**If the door alarm turns off too early**, screw magnet **in** so that the distance between the two elements is **increased**. Adjust the magnet gradually until correct operation has been achieved.

Finally, tighten the lock nut taking care not to disturb the magnet position.

## 4.8 MEASURING PUMP CURRENT

To establish the pump run current, first check the system current in the TEST Mode. Then the total current is measured as detailed below and the TEST Mode current deducted from total current to give pump current. If the printer option is fitted, the total current is shown on the printout header. If it is not, total current can be measured with a suitable multimeter in series with the RIS 12 VDC input at J1 terminal #2.

When the meter has been connected, switch the RIS on and take a reading during the normal sampling period. This starts immediately after the purge cycle. Do not measure the current during the purge cycle because the pump is running at a higher than normal rate.

It is not necessary to check the pump run current frequently but an excessive current is a good indication that a pump requires attention, or replacing. The following 'normal' range of pump current is provided for guidance.

**Low Flow Pump**, RIS systems with a flow rate of 250 mL/min. or less: 'typical' current range = **90 to 120 mA**. A pump current of 200 mA or more indicates a faulty pump that requires replacement.

**High Flow Pump**, RIS systems with a flow rate of 700 mL/min. or more: 'typical' current range = **250 to 300 mA**. A pump current of 400 mA or more indicates a faulty pump that requires replacement.

## 4.9 RESETTING THE PRINTER OPTION STORAGE

The stored data can be cleared any time. **Enter** the TEST Mode, press the HOLD/RELEASE key at any point in the cycle, and then press the PRINT key. Exit the TEST Mode to return to normal operation. Storage resetting can be verified by initiating a printout. The header will show 'printout CANCELED' in acknowledgment.

## 4.10 CLEANING THE SAMPLING INPUT AND OPTICS BLOCK

**4.10.1 INTRODUCTION.** The RIS draws the atmosphere to be monitored through the optics block. This assembly conveys the sample to the tape and houses the LED's (light emitting diodes), and photodiodes. These devices, respectively, initiate and receive the beam of light that is bounced off the tape and used to determine the sample concentration by measuring the stain density.

If the sample drawn through the optics block contains dust, other airborne particles or aerosols,

these substances will, in time, tend to coat the optic elements mentioned above. In addition, they may accumulate in the input tube and the air path through the optics block.

The effect of this process is to gradually degrade the performance of the optics block. This deterioration can progress to the point where the light level adjustment is no longer able to compensate. When this occurs, remedial action is necessary. The following information provides guidance on light level adjustment and cleaning procedures.

**4.10.2 LIGHT LEVEL ADJUSTMENT.** The acceptable light level range, (checked in the TEST Mode), is between **200** and **254** and applies to both tracks. Recommended practice is to check the levels at each cassette change and **adjust to 220 on the tape being used**. The 220 value allows for small naturally occurring changes in level, without the extremes of 200 or 254 being reached. The adjustment procedure is provided in Section 4.4.

**4.10.3 WHEN TO CLEAN.** Unless conditions are adverse, it is unusual for the air paths to need cleaning more frequently than every 9 to 12 months.

Be guided by experience and adjust cleaning frequency accordingly.

An exception to the norm is where there are significant sticky aerosols present in the monitored atmospheres. This situation can occur when MDI is sampled. In such cases careful regular cleaning of the input tube, and the air path through the block, may reduce the need for more extensive cleaning.

An indicator that cleaning is required is an inability to restore the light levels to the 220 value by means of the adjustment provided.

**4.10.4 HOW TO CLEAN.** To clean the input tube, unscrew the external clamping nut and the input assembly parts can be withdrawn. The actual sample tube can be easily gripped and removed if a short piece of a larger diameter silicone rubber tubing is put over it.

When it has been removed, clean the input tube with a cotton tipped swab (or similar) and, if required, use a **residue free** solvent spray.

**NOTE:** *RIS's with two input tubes (e.g., MDI systems) have different parts but the method of disassembly is similar.*

To clean the air passage in the block, put a piece of tape into the gate (tape from an old cassette can be used) and close it. Blow into the sampling port side of the block (after the input tube has been removed) to shift dust and loose debris. Then, open the gate and move a clean piece of tape into position.

Repeat several times, also with the gate open.

If a can of pressurized air is available, carefully position tube at the tape side of the gate and blow again several times. Suitable cans of air are usually available from photographic suppliers. A mechanical pump or bellows can be used but it may not be possible to blow from the tape side.

**NOTE:** Take care to ensure that any dirt, not trapped by the tape in the open gate, is removed. Clean both holes in twin hole blocks.

**Carefully** clean holes in block using a small amount of cotton wool twisted onto a sliver of wood. A normal sized cotton 'bud' or swab may be too large. If necessary, use a little **residue free** solvent spray on cotton wool as well. Afterwards, make sure that no debris has been left during cleaning process by blowing through again.

At this stage check the light levels to see if the cleaning has effected an adequate improvement. If it has, carefully reassemble the input tubes and, after replacing a serviceable cassette, recheck the light levels and put the system back into service.

**CAUTION**

*Make sure that the input tubes are properly engaged in the block or the instrument will not monitor accurately (Figures 2-4 & 2-5).*

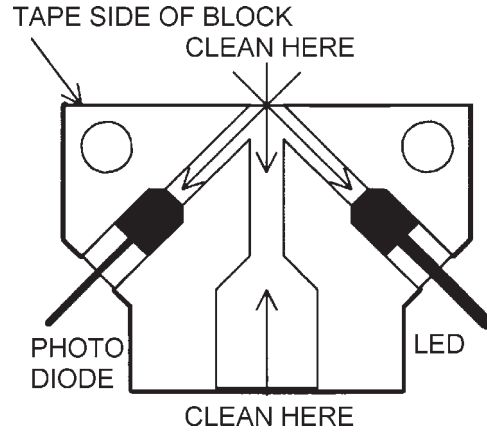
**4.10.5 DIRECT CLEANING OF THE LED'S AND PHOTO DIODES.** If the limited cleaning detailed above does not effect an adequate improvement in the light levels perform the following.

**NOTE:** This procedure requires removal of the optics block and should not be done without good reason.

Remove the cassette. If the input tubes have not already been removed, do so now. Take out the two slot-head screws securing the optics block to the mechanical chassis.

Carefully lift block without disconnecting the leads or putting them under undue strain. It is now possible to insert a small swab into the two holes in the block. This should be done from the **tape** side.

Gently find the angled cavities at the end of which are mounted the optic devices (Figure 4-4), clean both sides. Make sure that no lint or other particles are left behind, blow out if necessary.



**Figure 4-4. Cleaning Optics block**

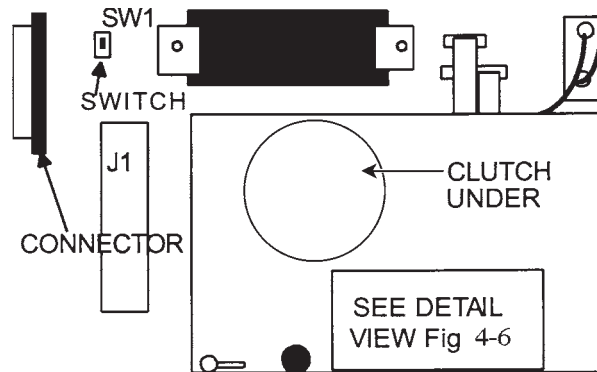
**4.10.6 REPLACING THE OPTICS BLOCK.**

Care is required when replacing the Optics block so that it is correctly positioned relative to the other half. It is first necessary to position the tape advance cam (on the left of the gate) so that it is vertical. This can be achieved in one of two ways:

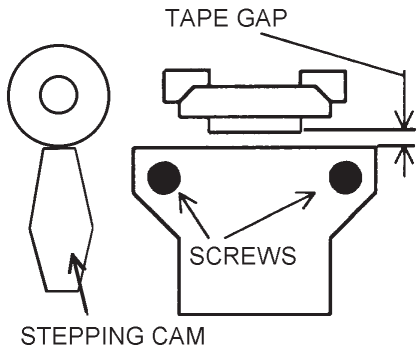
With switch SW1 turned off, find the take up clutch on the mechanical chassis beneath the top plate as shown in Figure 4-5. Turn the clutch by moving the light colored gear at the bottom of the clutch assembly (this is furthest away from the top plate and it can be seen without taking the mechanical chassis out of the RIS).

The clutch must be turned until stepping cam is vertical as shown in Figure 4-6. The gear is a little difficult to start turning because of the ratio.

The cam may also be positioned by turning switch SW1 'off', remove the top left of the unit as shown in Figure 4-5 and switch 'on' again, the stepping cam will turn continuously. By turning SW1 'off' at the appropriate point in the cam's rotation, it may be positioned vertically as shown.



**Figure 4-5. Finding Take Up Clutch**



**Figure 4-6. Stepping Clamp Vertical**

With the stepping cam vertical, and gate opening lever in the gate **closed** position, the optics block can be replaced and the two screws put in loosely. Position the optics block so that there is a gap of 0.020" to 0.040" (0.5mm to 1.0mm) between the two halves of the gate.

Ensure that the gap is parallel when it is measured. Note that the plastic tubes connecting the moving part can cause it to twist a little in its pivot. This can make the gap closer at the top or the bottom.

After initially setting the gap, tighten the block fixing screws to lock the optics block in position. Replace the connector (**with the switch 'off'**), then, verify that the tape steps correctly as follows.

Place a length of tape in the gate. This can be done by pulling a length out of a cassette which can be placed on top of the unit, or held in one hand.

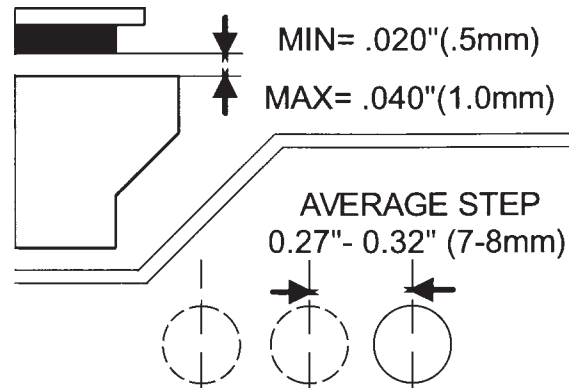
**Avoid touching tape with bare fingers.**

Switch 'on', and press the tape reset button to step on the tape. Mark the edge of the block on the tape with a pencil. Repeat the process until 4 or 5 steps are marked on the tape. Measure the length of the tape steps and take an average. The average step should be between 0.27" and 0.32", (7 to 8 mm).

If the steps are much longer, the cassette life will be less than the quoted 30-day maximum. In this case, the position of the optics block may be adjusted by repeating the above process, but reducing the gap gradually. Continue until a tape step of approximately 0.32"(8 mm) is achieved. **Do not reduce the gap to less than 0.020" (0.5 mm)** or tape drag in the gate may occur. This condition may be aggravated if the tape gets damp. Tape breakage can occur under these conditions.

**NOTE:** *In some cases it may not be possible to reduce the tape gap below about 0.030" (0.75 mm), in this case leave it set at that value.*

**NOTE:** *If it is not possible to achieve a satisfactory average tape step length, please refer to additional information in Section 4.21.2.*



**Figure 4-7. Summary of Gate & Step Values**

**4.10.7 WHAT TO DO IF CLEANING DOES NOT RECTIFY THE PROBLEM.** If performance cannot be improved, or if the change is marginal, it will be necessary to replace the optics block. A new optics block can be ordered from your distributor. When ordering the replacement block, specify the RIS system gas type and range, also the serial number. This information will ensure that the correct item is supplied.

It should be appreciated that if the block is replaced the original calibration of the instrument is no longer valid. It may be assumed that, because of manufacturing methods and testing, performance with a replacement block will be within 10% of the original. Factory re-calibration against gas is recommended as soon as is practicable.

A replacement block carried as a spare against future need is a wise precaution for those applications where contamination of the input tube and optics block is a problem.

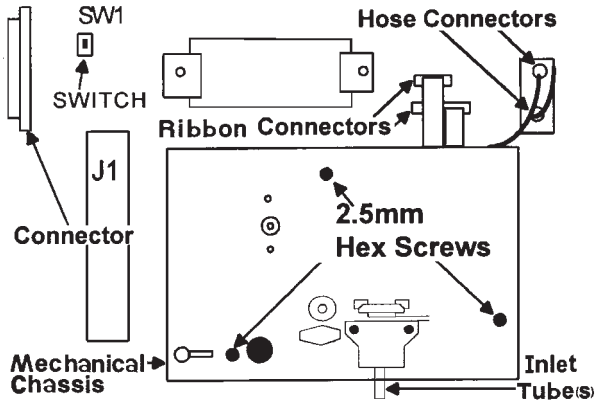
**4.11 CHANGING A PUMP**

Providing that care is taken, this is not a difficult procedure.

**4.11.1 PREPARATION.** Have available a replacement pump of the correct type. RIS systems with a Flow Rate of 200 mL/min. or less are fitted with the low flow pump and RIS's with a Flow Rate higher than 200 mL/min. are fitted with the high flow pump. These catalog numbers specify the pump complete with mounting bracket ready to fit.

Warn that the system is being taken out of operation and that alarms may be activated during the work. Remove external power from the RIS, open the door and turn off SW1.

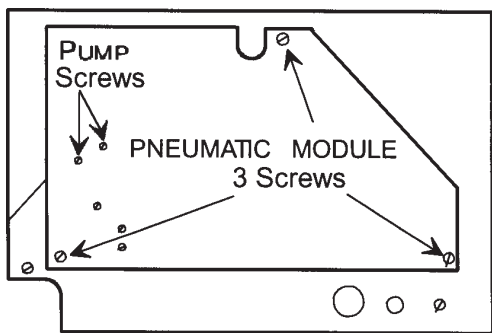
**4.11.2 REMOVAL OF THE MECHANICAL CHASSIS.** Remove the cassette, undo the two ribbon cable connectors and the two hose couplings in the tubes that connect the chassis to the body of the instrument. Undo the three (captive) cap head screws that secure the chassis (see Figure 4-8). A 2.5 mm hex key is required for this. The mechanical chassis can now be lifted out.



**Figure 4-8. Mechanical Chassis**

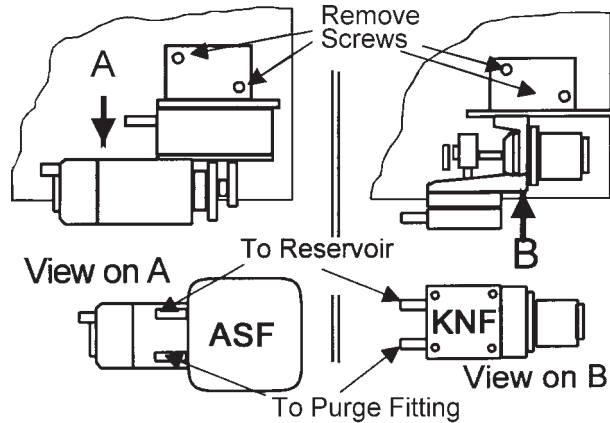
**4.11.3 PUMP REMOVAL.** Turn the chassis cover and remove three slot head screws (Figure 4-9) to allow the pneumatic chassis to be folded out to give access to the pump. **It is not necessary to disconnect and remove the module.**

Carefully disconnect tubes to the pump inlet and outlet. Note original orientation and position, for trouble free reconnecting. Disconnect input wiring, and remove screws holding pump which can now be withdrawn and discarded. Refer to Figure 4-10 which shows both pump types together with the orientation of pump connections.



**Figure 4-9. Pneumatic Chassis**

**4.11.4 FITTING THE NEW PUMP.** This is a reversal of the procedure detailed above. Take care that the correct pump is fitted and that everything is put back in the original orientation. Make sure that the pump moving parts are free to rotate without anything fouling them.



Corner of the Pneumatic Module is showing both types of pumps, ASF (high flow RIS) & KNF (standard RIS models)

**Figure 4-10. Pump Types**

**4.11.5 REPLACING THE MECHANICAL CHASSIS AND SETTING PUMP FLOW.** Carefully replace the chassis and route the tubes between chassis and body of the RIS as they were originally. Check that the tube connections are oriented correctly. Note, the blue tube (or white in some cases) should be at the top and the green (or clear) one should be at the bottom. Reconnect the ribbon cable connectors, and tighten the three screws.

The cassette can be replaced and power restored. Switch on SW1 and press the tape reset button.

Enter the TEST Mode and set the pump flow as described in Section 4.5.

On completion, return the system to service.

**4.12 EXTERIOR CLEANING**

An occasional wipe with a damp cloth is adequate in most circumstances. When oily or sticky deposits build up, a mild detergent solution on the cloth will normally remove them. Clean with the door shut and avoid excessive water. It should not be necessary to clean inside the instrument (except when cleaning the optics block as described in Section 4.10.5).

**4.13 KEY PARAMETER CHECKS**

It is recommended that the TEST Mode checks are carried out at each cassette change. These are as described in Section 2.8.

It is good practice to record the reading taken on the form provided in the back of this manual. If any value requires adjustment, the reading before and after should be noted. If a system 'fault' occurs the TEST Mode parameters at the time should be



entered. These practices, if regularly carried out, will build up an informative system history. This will show trends and prove a useful diagnostic aid should this be required. The time taken to check and record parameters for each cassette change is normally only a few minutes.

#### 4.14 MECHANICAL TIGHTNESS

It is good practice to carry out an annual check of mechanical security. The check should include:

**4.14.1 CABLE GLANDS.** Check that cable glands are tight.

**4.14.2 DOOR SWITCH.** Make sure that the door switch is correctly adjusted. The procedure for checking and adjustment is in Section 4.7.

**4.14.3 DOOR SEALS.** Ensure the door seals are effective. Also check that the door securing screws are in sound condition and not strained to the point that replacement is required. The door seals are reliable and seldom need attention. Door securing screws can be strained by over tightening and it is recommended that spares are carried. The catalog number is shown in Section 5.

**4.14.4 SAMPLE INLET.** It is **ESSENTIAL** that the input tubes is properly engaged in the block. Otherwise a suitable, undiluted, sample will not be conveyed to the point of measurement.

There is no reason for the tube to become displaced on its own, however the functional importance of this element fully justifies a careful check. Correct assembly of the input tubes is shown in Figures 2-4 and 2-5.

**4.14.5 INTERFACE TERMINAL SCREWS.** Check the screw in each used terminals for tightness.

#### 4.15 INPUT PATH CLEANING

Occasionally, check for excessive paper dust in the open tape gate. A check every 2 or 3 months is usually adequate. If it is required, blow the tape path and block clean with a hand bellows or can of pressurized air. The use of a factory air line is not recommended unless the air supply is known to be filtered and dry **and it is used carefully**.

More extensive cleaning is not normally required unless sampling conditions are very dirty, dusty, or otherwise adverse. If additional cleaning proves necessary, see Section 4.10.

#### 4.16 PUMP CHECK

Annually check the sampling pump for excessive current and noise (see Section 4.8). These checks do not require physical pump access but any further examination, or pump replacement, will require removal of the mechanical chassis in which the pump is mounted.

Indicators of excess current and noise, referred to above, may result from wear in motor bearings, or the eccentric. Misalignment or looseness of the motor relative to pump body is another possible cause. If wear is the problem, replace the complete motor/pump assembly. Misalignment, if not accompanied by wear, can be adjusted. For pump replacement catalog numbers see Section 5.

#### 4.17 CHARCOAL FILTER & TUBING CHECK

Annually, or biannually, access the pneumatic module (under the mechanical chassis), change the filter and clean the tubing as necessary.

#### 4.18 TROUBLESHOOTING GENERAL

The following sections assume the reader has appropriate competence and skill. In case of any doubt or difficulty refer to one of our Service Centers for expert assistance.

#### 4.19 EXCESSIVE INPUT CURRENT

Any increase in the input current should be investigated and accounted for. The most likely reasons for high input current are:

**4.18.1 HIGH CHARGING CURRENT.** This may be due to normal recharging after an extended period of power interruption and the system running on battery support. If this is the case the charging current will reduce to normal after a period of some hours. Other reasons for an increase in charging current include a badly adjusted input voltage (see Section 2.8.2.1), and a deteriorating battery.

**4.18.2 HIGH PUMP CURRENT.** The pump running current can be checked as described in Section 4.8. If it has increased significantly it is generally an indication that the pump is worn and needs replacing (Section 4.11).

#### 4.20 LOW PUMP FLOW

If the flow, when checked at cassette change, is found to have reduced **significantly**, check for the cause. These could be:

**NOTE:** *The sections below do not refer to the modest changes in flow that occur over a period of time and are quickly adjusted for with the appropriate potentiometer.*

**4.20.1 A FAULTY PUMP.** If this is the case, change the pump. Note that there are two pump types, which are fitted depending upon the RIS model. Refer to Sections 4.8 & 4.11 for guidance including typical pump running current. Check Section 5 for the correct catalog number.

**4.20.2 A BADLY FITTED INPUT TUBE.** Check to ensure that the input tube(s) is correctly fitted and that no leakage is occurring.

**4.20.3 A FAULTY TAPE GATE SEAL.** This problem is only likely after several years operation. It can occur through distortion, or wear, of the seal as a result of the opening and closing of the gate over an extended period. Replacing the seal requires special knowledge, and should be referred to one of our Service Centers.

**4.20.4 LEAKING OR LOOSE TUBING.** Check to ensure that all of the pipe work in the mechanical chassis is sound and properly connected.

## 4.21 EXCESSIVE TAPE USE

Cassettes lasting appreciably less than 30 days may be due to:

**4.21.1 MONITORED CONCENTRATION LEVELS HIGH.** During periods when significant levels are monitored, the system will use each track only once; it will also operate in the 'time mode' if the sample concentration is high enough. Both conditions will increase tape consumption.

**4.21.2 EXCESSIVE STEP LENGTH.** This can occur because an undue amount of tape is pulled through the gate at each step. The average step length should be 0.027" to 0.032" (7 to 8 mm) and the method of measuring it is described in Section 4.10.6. This condition, if present, may be caused by high take-up clutch torque, a weak pinch roller arm spring, a maladjusted tape gate, or a combination of these factors. Rectification is considered a Service Center repair.

## 4.22 TAPE BREAKAGE

Tapes can be damaged by careless insertion of a new cassette. Take care, as it is difficult to repair a broken tape. If the tape breaks during normal operation check that the tape is not damp which would reduce its strength. Tape breakage can also occur if the tape gate gap is too small. If this is the case, the take-up clutch will pull against the constraints of the gate causing the tape to break. The tape-gate gap can be checked as in Section 4.10.6.

If the two ends of a broken tape can be 'fished out' of the cassette body they can be repaired by careful joining with adhesive tape. The join must then be completely wound onto the take-up spool so that it does not pass through the tape gate when operation resumes.

### CAUTION

*Do not touch tape with bare fingers to avoid contact with chemicals on the tape.*

## 4.23 LIGHT FAULTS

If Light Faults occur, check (in the TEST Mode) that the light level values are at, or close to 220. If not, adjust as covered in Section 4.4. Make sure when adjusting that the tape in the gate, when the adjustment is made, is **clean** and not stained.

If the light level when checked is found to be correct at, or close to, 220 make sure that it is not possible that some external bright light (natural or artificial) does not shine directly up the input tube(s).

Remember that opening the tape gate without putting the system into the TEST Mode can cause a light fault as well as a spurious gas alarm.

If no apparent reason for frequent light faults is found refer to one of our Service Centers for assistance.

## 4.24 DOOR FAULT

If the door fault is intermittent or the door needs excessive tightening of the screws to turn it off, or if it cannot be turned off, adjust the switch. This is covered in Section 4.7.

## 5 SYSTEM SPARE PARTS

### 5.1 MODEL DEPENDENT PARTS

Some parts are model dependent (see the tables below). The other parts are common to all models.

#### 5.1.1 CASSETTE

INSTRUMENT CAT.#	GAS TYPE	CASSETTE CAT.#
2772-0010	TDI	2772-1010
2772-0015	TDI HIGH RANGE	2772-1010
2772-0020	HYDRAZINES	2772-1020
2772-0030	PHOSGENE (A)	2772-1030
2772-0035	VELCORIN®	2772-1035
2772-0040	CHLORINE	2772-1040
2772-0060	ARSINE	2772-1060
2772-0090	ACID GASES	2772-1090
2772-0095	HCI HIGH RESOLUTION	2772-1090
2772-0100	HDI	2772-1100
2772-0110	PHOSGENE (B)	2772-1110
2772-0120	MDI	2772-1120
2772-0150	IPDI (VAPOR)	2772-1150
2772-0160	TDI, MDI, IPDI	2772-1120
2772-0175	TDI HIGH FLOW	2772-1120

#### 5.1.2 OPTIC BLOCK

RIS CAT.#	NOTE	BLOCK CAT.#
2772-0010, -0020, 0015, -0035	High Sensitivity	2701-1490
2772-0030, -0060, 0100, -0110, -0150	Low Sensitivity	2701-1491
2772-0120	Aerosol	2701-1704
2772-0040, -0090	Low Sensitivity Coated	2701-1906
2772-0095	High Sensitivity Coated	2701-2472
<b>CAUTION:</b> Recalibration is Required After Replacing a Block.		

#### 5.1.3 BACK-UP BATTERY

RIS CAT.#	NOTE	BATTERY CAT.#
2772-0010, -0015, -0020, -0030, -0035, -0040, -0060, -0090, -0095, -0100, -0110, -0150	Battery (with resistor)	2772-2084
2772-0120, -0160 -0175	Battery (without resistor)	2701-1713

#### 5.1.4 PUMP ASSEMBLY

RIS CAT.#	NOTE	BATTERY CAT.#
2772-0010, -0015, -0020, -0030, -0035, -0040, -0060, -0090, -0095, -0100, -0110, -0150	Low Flow	2701-1748
2772-0120, -0160 -0175	High Flow	2701-2078

## 5.2 SYSTEM POWER SUPPLIES

### 5.2.1 SINGLE POINT

CAT. #	INPUT VAC	OUTPUT	TERRITORY
2772-2041	120	12V, 900mA	America & Canada
2772-2042	220	12V, 800mA	Europe
2772-2043	240	12V, 800mA	U K

### 5.2.2 MULTIPPOINT

CAT. #	INPUT VAC	OUTPUT	TERRITORY
2772-2022	120	12V, 1.8A	America & Canada
2772-2024	220/240	12V, 1.8A	Europe & UK

## 5.3 RECOMMENDED SPARES

CAT. #	DESCRIPTION
2701-0969	40mm Charcoal Filter
2701-1173	Tri-Lock Door Key
2701-1255	Tri-Lock Screw
2701-1311*	FEP Teflon 3" Inlet Tube, Low Flow
2701-0577*	FEP Teflon (above) bulk by the inch
2701-1424*	FEP Inlet Tube, High Flow in bulk by the inch
2701-1748	Pump Assy., Low Flow (Table #1)
2701-2078	Pump Assy., High Flow (Table #1)

\* See Section 2.6 (Sample Lines)

## 5.4 COMMON PARTS

CAT. #	DESCRIPTION
2701-1072	Polycarbonate Window **
2701-1638	Door Keypad <b>** order these two items together.</b> Not supplied separately
2701-1089	Trumpet Cable Gland PG-9
2701-1489	Polyglass Enclosure Assy. (Low Flow instruments)
2701-1716	Polyglass Enclosure Assy. (High Flow instruments ONLY)
2701-0695	Optics PCB Assembly
2701-1760	Baseboard PCB Assembly
2701-2246	Gate Mechanism Spring
2701-2256	Clutch Assy. (spring type)
2701-0101	Motor/Gearbox (Drives stepping cam and take-up spool etc.)

## 5.5 OPTIONS AND SUPPLIES

CAT. #	DESCRIPTION
2772-0251	Serial Printer Interface PCB
2772-2079	Portable Printer 110/120 VAC
2772-2078	Portable Printer 220 VAC
2772-2077	Portable Printer 240 VAC
2772-2083	Portable Printer Cable
2701-1347	Replacement Printer Ribbon
2701-1387	Replacement Printer Paper Roll
2772-2081	Alarm Module
2701-1761	Alarm Relay PCB
2701-2149	Test Card
2701-2505	Magnet (Used with Test Card)

## 5.6 SERVICE CENTERS

### Pennsylvania

Scott Instruments  
 251 Welsh Pool Road  
 Exton, PA 19341  
 Phone: 610-363-5450 or  
 1-800-634-4046  
 Fax: 484-875-1610

Bacharach  
 621 Hunt Valley Circle  
 New Kensington, PA 15068  
 Phone: 724-334-5051  
 Fax: 724-334-5723  
 E-mail: help@bacharach-inc.com

## SUPPLEMENT A

### A1 EARLIER RIS BASE BOARDS

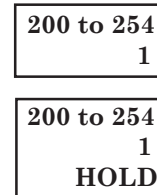
#### A1.1 ADJUSTING LIGHT LEVELS ON PHASE 1 RIS UNITS

Several references to RIS's manufactured before April 1992 with phase 1 base boards have been given in the main manual (Sections 1.1, 1.3.7, 2.8.2.1, & 4.4) Any references to Figure 2-3 should be referred to Figure S-3.

The light level adjustment POTs for boards manufactured before April 1992 are mounted **under** the tape cassette which has to be removed before the light levels can be adjusted as explained below:

Enter the TEST Mode by pressing the red button on the back of the door. Wait until the display has cycled to show:

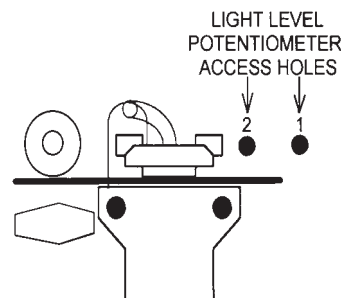
Press the HOLD/RELEASE button on the front panel firmly so that the display shows:



**Figure S-1. Test Mode**

This display status will be maintained for 5 minutes, or until the HOLD/RELEASE button is pressed again.

Adjustment is made by means of the two potentiometers that are located under the cassette position and accessed through holes in the top plate. The light level track 1 is adjusted by one, and track 2 by the other. The potentiometer access holes cannot be seen until the cassette is removed. See Figure S-2.



**Figure S-2. Pre-4/92 Light Level Access Holes**

**Adjustment method 'a'.** Make sure that tape in the gate is clean and unstained. Close the tape gate. Observe the displayed light level for track 1 and decide if it needs increasing or decreasing.

Open the tape gate and remove the cassette, turn the appropriate potentiometer a little **clockwise** to **decrease**, or **counter clockwise** to **increase**, the light level.

Reinstall the cassette and check the light level value; if necessary repeat this process until a value of 220 is achieved.

**Adjustment method 'b'**. Remove the cassette and pull out a loop of several inches of tape. Insert a portion in the gate while the cassette is held in one hand; or placed on the top of the RIS. **Do not touch tape with bare fingers to avoid contact with the chemicals on the tape.**

With the tape in the gate and the cassette supported in one hand, adjust the potentiometer with the other hand until the reading is 220. **Counterclockwise** rotation of potentiometers **increases** the level.

**When track 1** has been adjusted by either of the above methods, press the HOLD/RELEASE button to allow track 2 to be displayed. HOLD this display as before and adjust the same as track 1.

**After adjustments** have been made, rewind the tape pulled out of the cassette (if the second method was used). Replace the cassette and close the gate. Exit the TEST Mode by pressing the red button on the rear of the door again, unless other tests have to be done.

Exit the TEST Mode by pressing the red button on the rear of the door again, unless other tests have to be done.

SILK SCREEN IDENTS		TERM. #	CONNECT TO
CHARGER INPUT	S	1	Connected already to the power supply regulator on the board
	V+	2	
	OV	3	
ANALOG OUTPUT	OV	4	Analog Output
	O/P	5	
NETWORK COMMUN- ICATIONS	N11	6	Not Used See Below
	N12	7	
	N13	8	
SERIAL PRINTER INTERFACE	PI	9	Serial Printer Interface
	PO	10	
	PRDY	11	
	PPRS	12	
	OV	13	
		14	A IN A OUT Network B Communications S
		15	
		16	
		17	
ALARM RELAY CONTACTS	NC	18	Alarm Relay Contacts
	C	19	
	NO	20	

Figure S-3. Phase 1 Base Board Terminal Strip Identifications

ALTERNATE IDENTS ON EARLIER SYSTEMS			TERM. #
CHARGER		0 V	1
INPUT	VCH	+ V	2
		0V	3
		0 V	4
			5
		SP 1	6
		SP 2	7
		SP 3	8
		SP 4	9
			10
			11
			12
			13
			14
RELAY		FAULT/	15
3		ALARM	16
		RELAY	17
		2	18
		RELAY	19
		1	20

Figure S-4. Phase 2 (Early Version)  
Base Board Terminal Strip Identifications



# GMD SYSTEMS BACHARACH®

## RIS TEST/FAULT PARAMETER LOG SHEET

### SYSTEM INFORMATION

MODEL NO.	
SERIAL NO.	
GAS TYPE	
ALARM LEVEL 1	
ALARM LEVEL 2	
CURVE NO.	
SOFTWARE VERSION	
LOCATION	
OPTIONS:	

Completion of log by entering the test values for each parameter will provide a valuable record and aid planned maintenance. Any value that tends towards, or reaches, a limit value indicates that adjustment or intervention is required. Trouble free and optimum performance is aided by planned maintenance guided by test results. Carry out a test mode check:

**EVERY CASSETTE CHANGE OR IF A FAULT OCCURS**

Display Read Out	V	mA	Test 1	Test 2	Test 1	Test 2
Parameter	Battery Voltage	Supply Current	Light Level 1	Light Level 2	Flow 1 mL/Min.	Flow 2 mL/Min.
Nominal Value	6.9	See Note 1	220	220	*	*
Limits	6.0/6.9	40/318	200/254	200/254	**	**
Date	* Insert nominal value from specification ** Insert nominal value + -10%					

**NOTE 1** The mA value displayed in the test mode depends upon several factors. Assuming an average specification system and fully charged battery a reading of 60-90 mA is typical. The pump when running (not in mA test) will add an extra 90-110 mA typically to give a total of about 150-200 mA. This total current is shown on print-out (if printer is fitted) or may be measured with a meter in series with the input at terminal 2. If battery is recharging, following a period of loss of input supply, a higher charging current will increase above values.

LIGHT FAULT TRACK 1  
 LIGHT FAULT TRACK 2

BATTERY BACKUP  
 BATTERY LOW  
 FLASH

CASSETTE  
 PUMP FLOW  
 FLASH